

HAND BOOK ON SCIENCE CLUB ACTIVITIES

Editors :

Dr Sabita P Patnaik
Dr J Seetharamappa

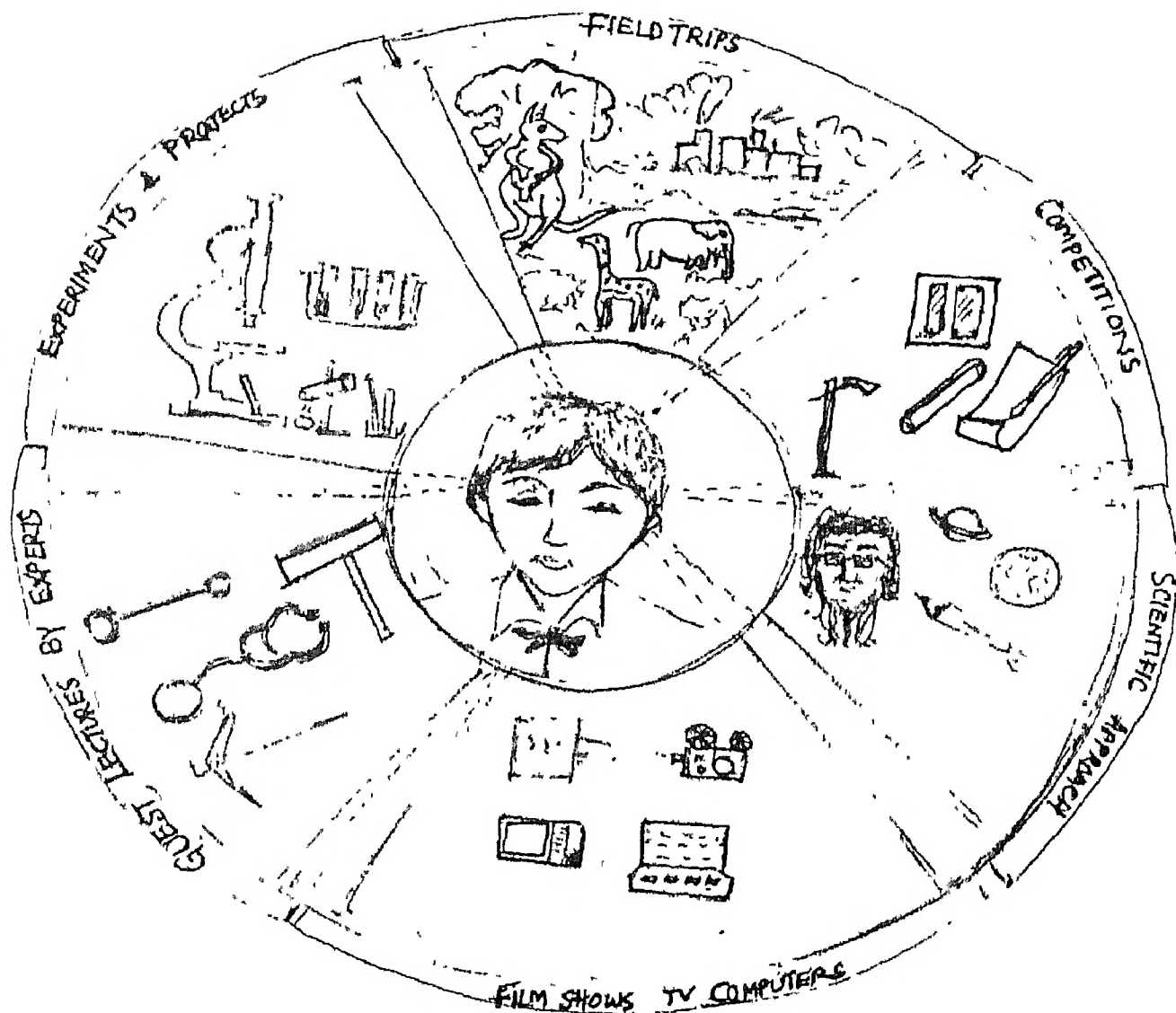


REGIONAL COLLEGE OF EDUCATION, MYSORE 6

(NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
NEW DELHI)

1993

HAND BOOK ON SCIENCE CLUB ACTIVITIES



REGIONAL COLLEGE OF EDUCATION, MYSORE-570006
(NATIONAL COUNCIL OF EDUCATIONAL RESEARCH & TRAINING)
NEW DELHI

FOREWORD

Science constitutes a very important learning area in the school curriculum. Science is taught in schools not only to impart knowledge in the form of scientific facts, principles, laws and generalizations but also to develop attitudes and qualities of mind that are distinctive of the scientific activity like curiosity, spirit of inquiry, open mindedness, respect for facts, suspension of judgement in the absence of evidence, desire to experiment and verify and so on. Effective science teaching should lead to the development in the learner both the cognitive and non-cognitive outcomes. Obviously, this comprehensive range of objectives of science teaching cannot be achieved through classroom teaching alone. It calls for the involvement of the learners in a variety of scientific activities where they participate actively to find out things themselves. It is in this context that science clubs acquire great importance in schools.

Science clubs have as their main objective the involvement of the students in scientific pursuit through various activities in order to help them to extend their knowledge of the world they live in, develop understanding of the scientific method and inculcate scientific temper. The present handbook on science club activities edited by Dr. Sabita P. Patnaik and Dr. J. Seetharamappa seeks to help science teachers to understand the various aspects of science clubs including objectives, organisation, planning and implementation of activities and their evaluation. This handbook is the outcome of a workshop involving science teachers and teacher educators conducted under the academic coordination of Dr. C. A. Padmanabha Rao, Field Adviser, NCERT, Hyderabad. The handbook project was taken up in response to a specific request made by the Andhra Pradesh Government for technical support for teachers in its programme of expanding science club activities in all its schools. We hope that this handbook would fulfil the expectations of science teachers in organising meaningful science club activities.

Prof. C. Seshadri
Principal
Regional College of Education
Mysore

ABOUT THE HANDBOOK

The rapid expansion of scientific knowledge in recent years and the relevance of science for the better adjustment of an individual have made it imperative to make every individual scientifically literate, to develop scientific attitude and to solve problems by applying the scientific method. Due to some constraints the present classroom teaching does not cater to the needs of the young children i.e. it comes in the way of their being able to satisfy their curiosity, prevents them from being actively involved in and outside the classroom. It also does not help students to understand and apply some of the basic concepts and principles of science, to learn scientific inquiry skills and scientific methods of solving problems. It does not nurture creative talent and help them from taking certain decisions which improve life and develop desirable attitudes and values. Hence there arises a need of a forum like science club in school, where through interaction the students can update their knowledge and by participating in some of the activities related to science can get a chance to observe, investigate, solve problems, interact and communicate. In addition to this, interaction and participation may also enhance their social skills, leadership quality, creativity, etc.

The science club activities increase the duties and responsibilities of the science teacher and it is extended beyond the boundaries of the classroom. The cooperation of the administrator also increases slightly than expected for the success and smooth running of the club. The establishment of science clubs, planning and organisation of different activities also demand need for the orientation of science teachers during preservice and inservice training. Science club is not a totally new concept. Many schools have science clubs but unfortunately they do not function effectively due to lack of clear vision about organisation and activities, proper direction and guidance. Therefore, it is felt that a handbook on science club activities is to be developed, which would be helpful for teachers as well as for students, administrators, teacher trainees and teacher educators.

In view of disseminating the knowledge of organising the science clubs in schools, the Directorate of School Education/SCERT, State Coordination Committee (SCC) to hold a workshop for developing a hand book on science club activities for the benefit of science teachers and teacher — educators in establishing science clubs in the schools. As a result of which, a workshop entitled 'Workshop on preparation of hand book for science club activities' was organised by the Regional College of Education, Mysore (NCERT) under the

academic coordination of Dr.C.A.Padmanabha Rao, Field Adviser, NCERT, Hyderabad. The draft of the hand book prepared in the workshop is the outcome of the collective effort of the participants and resource persons. The draft was finalised after incorporating the suggestions and comments of experts in different branches of science.

We are thankful to Dr.C.A.P.Rao, the Field Advisor and Dr.Chisty, the Assistant Field Advisor, NCERT, Hyderabad for their interest, encouragement and valuable suggestions during the workshop. The appreciation and thanks go to all the participants/resource persons for their zeal, sincere effort and ability with which the present handbook is developed. Thanks are also due to Prof.V.Sukumar Reddy, Head, Department of Science, SCERT, Sri A H Devadas, Prof.M R Narayanan and Sri A A Kadri for sharing their ideas and knowledge during the workshop. The Director and the staff of SCERT, Hyderabad deserve our praise for providing necessary help and facilities in conducting the workshop effectively. We are also thankful to Mr.P.R.Rao, Dr.G.T.Bhandage, Dr.Manjula P. Rao and Mr.S.P.Kulkarni for their valuable suggestions and comments to bring about the modification and finalisation of the handbook.

We express our sincere thanks and appreciation to Dr.C.Seshadri, Principal, Regional College of Education, Mysore for taking keen interest in bringing out this material in the form of a book. Our acknowledgments are due to Dr.A.C.Banerjee former Dean and Head of Science, Regional College of Education, Mysore for encouraging us to take part in the workshop.

Our thanks also go to Mr.Venkataramana and Mrs.S.Imavathi for typing the manuscript.

We hope that students, teachers, administrators, teacher trainees and teacher educators will find this handbook useful in understanding the philosophy of science club, its organisational structure, planning, implementation, evaluation and follow up of different activities. Suggestions from all concerned for further improvement of the hand book is appreciated.

Dr.Sabita P Patnaik
Dr.J.Seetharamappa
Resource persons and Editors

C O N T E N T S

Page Nos.

I. Introduction	1
II. Objectives of the Science Club	2
III. Organisation of the Science Club	2-7
IV. Planning and Implementation of Strategies of the Science Club Programme	7-10
V. Suggested Activities for the Science Club	10-92
VI. Evaluation of Science Club Programmes	92-95

References

Appendix

I Introduction

Children are basically active and curious. It is their natural urge to make things, break things, and handle things. But the present classroom teaching does not provide ample opportunities for them to construct, solve problems and pursue their interest independently. There is no scope for them to improve their creativity and know about the advancement in various fields of science. Learning for them is not a joyful experience. The present day teaching also takes the students away from the world of work and it does not encourage group work, spirit of service and responsibility etc. Hence, there is a need for a forum which shall take care of the freedom, self expression, spirit of inquiry, independent, group work, etc. Therefore, the idea of starting science clubs arises where a few likeminded individuals get together and share their ideas and common interests through discussion, experimentation and other activities. As the spirit of science is the spirit of discovery, the children experience the joy and adventure of scientific discovery in a science club, where the atmosphere is informal, freedom is more and the opportunity for specialisation is provided. The science club forms the backbone of the school in which various extra-curricular activities related to science are undertaken to bring out the hidden talents, to develop certain skills and to inculcate scientific temper among the students.

Importance of science club

1. Motivates student members to study science through practical applications.
2. Provides opportunity for advanced/extended study of various fields of science.
3. Provides opportunity for pursuance of special interest by selected individuals.
4. Provides educational and vocational guidance.
5. Improves student-teacher relationship
6. Makes learning of science more entertaining and enjoyable.
7. Establishes and develops scientific awareness in the society.

History

The movement of science club first started in USA and USSR. In India, similar movement started in 1957-58 under the direction and funding of the government. By 1962 only,

500 clubs have started and 900 by 1965-66. With the organisation of science club sponsored workshop, the NCERT tried to promote the effectiveness of the science clubs. Some of the SCERTs and other institutes conducted seminar and workshops for the science club sponsors to give momentum and promote science club activities.

II Objectives of the science club

1. To inculcate scientific attitude/temper and to provide opportunities for training in scientific methods.
2. To develop habits of exploration and of creative and innovative aspects.
3. To develop interest in scientific hobbies and utilisation of leisure properly.
4. To widen the outlook and enable students to apply the knowledge in certain life-situations.
5. To develop in children, a sense of healthy competition for a better cause.
6. To keep the students in touch with latest developments in science and their effects on human beings.
7. To give opportunities to bring forth the hidden talent.
8. To develop the power of keen observation.
9. To provide an outlet for pent-up emotions of children and channelise their energy towards desirable goal.
10. To promote entertainment oriented science learning.
11. To explore local resources, to learn to maintain and protect the environment.
12. To give opportunities to develop scientific skills.
13. To popularise science among the laymen.
14. To give ample opportunities to students for problem solving.

III Organisation of the science club

Facilities

Carrying out the activities of a science club requires an enthusiastic science teacher, the sponsor, some essential equipments and a separate room. If the room is not available one can go for the laboratory or even a classroom as well. The facilities like electricity, water supply and heating

arrangement could be provided to the extent possible. The other materials required can be borrowed from the laboratory or from a neighbouring school.

Naming the science club

The science club can be named after a scientist/scientific invention. Any other suitable name can also be given.

Size

Initially the size of the club can be small with a few interested and enthusiastic students. For this, the science teacher will have to play a major role in selecting the student members. The size of the club may vary from year to year depending on the interest of the students. Equal opportunities may be given to all the classes while selecting the members. This may motivate others in the class to join the club later. If the number of student members is more than then the sponsor can divide them into more groups.

Membership

The interested students may apply for membership in writing in a prescribed form to the sponsor. The members should abide by the rules and regulations of the club and should actively participate to achieve the objectives of the club. Membership may be cancelled at any time by the executive body if a student member fails to live upto the expectation or as required.

Executive body

It may consist of a president, one or two vice presidents, secretary, joint secretary, treasurer, store keeper, librarian, reporter and all the class representatives. An enthusiastic and dynamic science teacher can act as the president. The other members of the executive body can be selected or elected from the student members. Even president can be selected/elected from the student members.

Duties and responsibilities of executive body

1. They prepare the action plan for carrying out the activities of the club.
2. They meet as and when required to decide the detailed programme of the activities.
3. They can expel or admit a member.
4. They evaluate all the activities of the club and present the same before the general body.

5. The body selects or nominates the members for various committees.
6. All activities of the committees will be supervised by the executive body.
7. They prepare the budgets, maintain proper accounts, and submit the reports to the general body for approval. Two auditors, one from teachers and the other from student have to be appointed for auditing the account, before submitting to the general body.
8. The body can incorporate new activities in the science club.

Committees

The executive body may form the following committees by selection/election to cover all the activities planned by science club.

1. Exhibition
2. Field trips/excursion
3. Competitions
4. Magazine
5. Projects
6. Audio-visual
7. Seminar
8. Evaluation

However, other committees may be formed depending upon the requirement of the club. One member secretary assisted by 2 or 3 members, all from student community form a committee. They have to plan, organise and evaluate the allotted activities in a systematic way.

Duties and responsibilities of the members of the executive body.

President

1. The president shall preside over the meetings of the science clubs, special talk programmes, debates, seminar, etc. organised by the club.
2. He shall guide and supervise the functions of the club, give decisions and shall exercise all powers of the executive in times of urgency subjects to the ratification in the next executive meeting.
3. He shall be the editor and publisher of the club magazine, newsletter, etc.

4. He shall be the ex-officio chairman of all the committees of the club. He may, however, nominate any other office bearer to be the chairman on his behalf.

5. He shall have the power to remove the student secretary of any committee if any of them fails to discharge the duties properly.

Vice President

1. The vice president (may be two in number depending upon the size of the club) shall perform such functions as entrusted to them by the executive body. One of them shall act as president in his/her absence. They shall help in good conduct of the science club activities. They shall be responsible even to provide guidance to the committees in all their organisational matters.

Secretary

1. The secretary has to maintain all the records of the club as directed by the president, the executive body and the committees of the club.

2. He/she has to convene, in consultation with the president the meetings of the executive of the club whenever deemed necessary.

3. He/She has to implement the policies and programmes of the club as enunciated in the resolutions and decisions of the executive.

4. He/She has to participate and supervise the functions of the club in co-ordination with the president and the vice president.

Joint Secretary

One or two joint secretaries may be selected/elected to assist the secretary in the day-to-day proceedings and in other functions as desired by him.

Treasurer

1. He/She has to maintain the accounts of the club.

2. He/She has to submit to the council or the executive body the financial statement in every meeting

Finance

School can finance the club in the earlier stages. If there are no funds, then a nominal fee of Re.1/ or even

such as donations from public, interested parents, local authorities, industries, social organisations like rotary club, lions club, etc. Some amount in the form of entrance/gate fee for exhibition/variety entertainment (drama, magic show, etc.) can be collected.

Teaching aids/toys/chalk/cosmetics/soaps/mushrooms/seed packets/potted plants/vegetables/manures prepared by the members can also be sold and the amount collected can be used for science club activities.

Rules and regulations of the club

1. Any student interested in the aims and objectives of the science club shall be eligible for the membership of the club.
2. Application for the membership must be made in writing to the sponsor/president of the club.
3. Any individual satisfying the norms set up by the club can continue to become a member.
4. Members must attend meetings regularly. Three consecutive absences without satisfactory reason (genuine reason of absence must be intimated to the president/secretary) will be considered cause for dismissal from the club.
5. At the beginning of the academic year the rules and regulations, if necessary, shall be revised.
6. If any member of the executive body resigns, the post should be filled by selection/election at the earliest.

The rules and regulations of the club formulate the constitution of the club.

The role of the sponsor

The teacher-in-charge of science club i.e. sponsor should possess some special characteristics as he/she holds additional responsibilities. He/she should be

1. resourceful, enthusiastic, dynamic and should possess the spirit of sacrifice.
2. able to guide the club members to fulfil the objectives of the club.
3. cooperative, sympathetic and creative.
4. intellectually mature and open minded.

7

In a nutshell, the sponsor guides the science club members to proceed in the right path and to reach the destination.

Tips to the sponsor

The following hints would help for the better organisation of the club.

1. Talking face to face is more effective than any other form of communication.
2. Effective leadership depends on group decisions and reinforcement.
3. Personal interests make big differences to students. The students are kept in tact when their interests are paid attention to.
4. Effective groups do not just grow and persist, they must be built and maintained. Good group work requires organization, recording, regular meetings and periodic review of results, etc.
5. Get enough students to do the job. Over worked students stop getting into action.
6. Recognise and reward good work.

V Planning and implementation strategies of the science club programmes

The success of any programme depends on the effective planning. During planning a number of people think together, discuss the matter thoroughly, come to a common agreement and formulate a plan of action considering various prevailing factors and feasibility. The following points have to be kept in mind for planning and implementation.

Preliminary decisions

1. Duration of club activities

The science club activities may be started 15 days after the re opening of the school and extended throughout the year upto 15 days prior to annual examinations. However, this may be changed according to the convenience of the school.

2. Number of meetings

A number of meetings are to be conducted for effective planning and implementation. The meeting times vary depending upon the requirements of the club and convenience.

of the members. Meetings may be conducted fortnightly/monthly. These meetings may be held preferably after school hours or even in holidays. However, if any free period is available, the meetings can be called during school hours also. The first meeting of the club may be held before the inauguration of the club. This meeting serves to decide aims and objectives and name of the club, establish membership qualifications, decide membership dues and other sources of income. The sponsor of the club may call the first meeting to introduce youngsters to the type of activities, to stimulate and energise the prospective members. The first meeting should be followed by the election/selection, appointment of different committees and formulation of the constitution of the club. The constitution of the club is to be formulated by the executive body. The last meeting has to be conducted before the valedictory function in which the review of the activities of the whole year and preparation for valedictory function are to be discussed. Special meetings may be called by the president in between at any time. The agenda for each meeting has to be planned by the office bearers of the club. In a general meeting, reading and review of the minutes of previous meeting by the secretary, reporting by the treasurer and the future activities to be undertaken are to be discussed.

3. Setting up of programmes.

The inauguration of the club may be done preferably after 3-4 weeks of re-opening of the school and valediction may be held before two weeks of annual examinations. The executive body decides the activities to be conducted for one academic year after thorough discussion in the meeting, prepare an action plan based on which a calendar with a list of activities may be brought out. Individual committees take up the responsibility of various assigned activities. The following points have to be kept in mind while preparing the action plan for a year.

- i. Availability of time
- ii. Size of the club
- iii. Availability of resources, finance and existing physical facilities
- iv. Needs, interests and capabilities of students.
- v. Needs of school and society, etc.

Preparation of action plan

A tentative action plan may be prepared to carry out various activities as shown below.

Action plan of the club activities for the year

Sl. No.	Name of the month	Activities/Suggested	Remarks
1.	July	1. Special talk 2. Audio visual programmes	In connection with inauguration.
2.	August	1. Initiation of wall magazine 2. Competitions-quiz, debate	
3.	September	1. Initiation of science club magazine 2. Field trips to nearby places	
4.	October	1. Activities related to wild life conservation 2. Excursions	Wildlife Week
5.	November	1. Activities such as painting, slogans, processions, elocution in connection with environmental awareness.	Environment month
6.	December	1. Guest lectures by experts 2. Experiments/Demonstrations	
7.	January	1. Competitions, drawing and essay writing 2. Finalisation of science magazine	Republic day
8.	February	1. Seminars, exhibitions and science fairs	National science day
9.	March	1. Special talk 2. Review 3. Valedictory function	

Note : The above mentioned action plan is flexible. It can be prepared considering events of scientific importance, availability of time, climate factors, etc. Projects/survey/case studies/experiment/preparation of model/improvisation of apparatus and other activities may be carried out throughout the year.

4. Strategies for implementation

The details of implementation of the activities shall be worked out a month in advance by the planning committee at its regular meetings. The number of activities may be listed and various committees take care of the assigned activities, make necessary arrangements and contact the concerned people well in advance. Different committee members should initiate, stimulate and give proper directions to the student members to carry out different activities. Continuous interaction and supervision enhances the success of the different programmes of the club.

The executive body should ensure the proper implementation of the activities, suggest alternate activities and take up a follow-up action.

V Suggested activities for science club

1. Competitions
2. Seminars, symposia, panel discussion, and olympiad
3. Collections/preservations
4. Science corner/question box
5. Special talks
6. First aid training
7. Demonstrations
8. Improvisation
9. Science exhibitions/science fairs
10. Gardening/plantation
11. Bulletin boards, wall magazines
12. Preparation of useful articles/preparation of useful materials using waste materials.
13. Pursuit of hobbies
14. Night sky observation (Astronomy)
15. Dramatics/role plays/magic and fun games
16. Service to the community
17. Field trips
18. Science projects
19. Science museum
20. Tackling day-to day problem using scientific principles
21. Aquarium, vivarium and terrarium
22. Science magazines, science newsletters, handwritten book.
23. Vocational guidance
24. Science library
25. Film shows and other audio visual programmes
26. Use of computers
27. Bird watching
28. Inventories
29. Other activities

Competitions

Competitions are essential activities of the science club. Here the children learn to develop a healthy competitive spirit which in turn helps them in identifying their aims and ambitions. By participating in these competitions they not only widen their knowledge but also gain a lot of confidence which would help them to face the competitive world.

Debates, elocution and essay writing help the student to improve their cognitive domain. They also feel confident enough to face the evergrowing challenges of the life bravely. They increase their vocabulary, writing skills and gain knowledge of the latest developments in science.

Competition can be conducted at three levels - primary, secondary and senior secondary levels.

Quiz

This is an activity where the children in a group of either 4-6 or an individual are faced with multiple questionnaires. It is done under the guidance of quiz master (either a student or a teacher). He asks questions to the various participants or groups of children turnwise.

It could be conducted orally or written. The questionnaires may be prepared on the related subject matter or any other topic for example,

1. Environmental awareness
2. Chemistry in the field of medicine
3. Electricity and magnetism
4. Genetic engineering

The topics for the quiz has to be communicated a couple of days in advance so as to enable the children to prepare themselves adequately.

Organisation

1. Questions must be clear, simple and to the point.
2. Grouping of children, priority of questioning, etc. must be decided by lottery.
3. The time allotted for answering a question could range from 15-30 seconds.
4. In awarding the marks, more credit has to be given for the team which answers first and then to the team which answers after a pass on.
5. All questions are to be framed according to the level

of the participants and should be of same difficulty level.

6. The team should not be very large.
7. In each team pupils from different classes may be accommodated equally as far as possible.
8. A stop clock to note down the time and a bell to indicate the time may be used.
9. A score board may also be used.

Use :

This activity helps in widening the children's knowledge. They become aware of the recent developments in science and above all it helps them to quicken their speed of response.

Quiz could be conducted fortnightly and the time duration could be approximately an hour.

Essay writing

For essay writing a topic is chosen from science, for example,

1. Hazards of pollution
2. Depletion of ozone layer and its effect upon mankind.
3. The disadvantages faced due to the rapid growth of industrialisation.

This competition should be made open to all the interested students.

Organisation

Essay competitions can be conducted in two ways.

1. The topic is given just before the commencement of the essay competition i.e. on the spot.
2. The topic could be given a day or week earlier and the children come prepared for writing the essay.

Two or three teachers would be asked to evaluate the written essays. The areas of evaluation could be

1. Language
2. Content
3. Method of presentation

Generally the time allotted is one hour. It could go on for 1 1/2 to 2 hours also. Marks will be allotted to each essay by the respective evaluators. The best essay could be published in the school magazine.

Essay writing could be conducted monthly.

Uses

This improves the scientific knowledge and the writing ability of an individual student.

Debates

For debates the topic chosen should be such that one can argue on it i.e. for or against the given topic.

Organisation

The time duration for each participating student should range from 7 to 15 minutes. The number of participants should be well balanced in both groups.

The students will have to present their views, in support of the topic or against the topic alternatively. After the debate is over, the group leader in each group should be able to compile all the talks given by his opponents and give his contradictions if he wishes so.

The judges may be chosen among the science teachers or parents who are experts in the field. They would judge the participating students considering the following points.

1. Presentation
2. Its relevance to the topic
3. Content etc.

After the completion of the debate, a few students from the audience may be invited to present their views on the topic if any. The best student participant of the debate competition would be given a small prize or a certificate during the assembly.

Uses

Debates enhance the communicating, analysing, criticizing, argumentative skill, etc.

Elocution

The topic selected for this activity should be related to science. Generally ambiguous topics are not preferred. The topic for elocution is given atleast two or three days in

advance so that the student participants may be able to refer books and manuals and obtain the necessary information relevant to the topic.

A time period of 5 to 15 minutes is allotted to each participant. A team of judges comprising of two to three science teachers can be formed. They will evaluate the allocation considering the following points.

1. Presentation
2. Content
3. Expression etc.

A stop clock and a bell may be required to denote the time.

Uses

This activity enhances the power of speaking, helps the children to overcome stage fear and help them in speaking boldly on public platform.

What's the good word?

Here one student from each team is told the correct answer which he has to in turn derive from his team mates by offering them 3 clues.

Organisation

Three to four groups of 3 to 4 children may be allowed to participate. The rules governing this activity are listed below.

1. Only one word/sentence is given as a clue.
2. Three chances are given.
3. After three chances, the team mates from other group are given one chance each.
4. Equal number of such questions are asked to each group.
5. The team which answers the maximum number of questions is adjudged as the best group.

This activity could also be conducted once in a month.

Uses

By this activity the children improve their understanding ability and would also get to know the concept thoroughly.

Painting on scientific themes

This activity could be made open to all interested children.

Organisation

1. The particular theme on which the painting is to be conducted could be given a week in advance.
2. The best few paintings could be selected and displayed either on the bulletin/display board, classrooms, laboratories, etc.
3. Two to three judges could be selected from the science teachers to evaluate these paintings.
4. This activity could be conducted once in two months.

For all the above competitions, a detailed time table has to be planned well in advance in the beginning of the academic year and it should be mentioned in the school diary so that the children would be aware of such competitions, their dates, venue and time.

Seminars

It is an activity or a programme wherein a person gives a conceptual explanation of a topic. The topic may or may not be related to the curriculum. It may be in-depth study by means of library work or experiments or data collection. Usually the duration of the activity depends on the topic and is decided by the participant himself. The duration may range from 5 minutes to even an hour. A seminar is organised by assigning the students different topics and asking them to present their papers before other group followed by a discussion. In seminar, the participant may use projector, slides, models, charts, etc. apart from a black board.

Organisation

Seminars can be arranged once in a month starting from August to January. A fixed day in every month say, first Thursday may be decided by the seminar sub-committee. The seminars can be arranged at three levels viz. primary, secondary and higher secondary. Depending on the number of participants and convenience, the seminars for three different levels may be arranged on two or three different days or on the same day. The science club members can participate in inter-school seminars, inter-district seminars or in inter-state seminars conducted by other science clubs or organisations or even by their own science club.

The topic may be announced at least fifteen days before the exact date of the seminar. The list of participants of the seminar should be finalised by the executive body. This can be done after studying the list of willing members to participate in the seminar. A few days before the seminar the details of the persons delivering it, the event etc.

venue may be displayed on the science club notice board. Usually the seminar can be conducted in the evening after the school hours. The necessary arrangement on the seminar day can be done by the seminar committee. The best seminar of the year can be finalised by a team of judges and a prize may be awarded in the valedictory function.

First the chairperson or president is chosen. He should normally introduce the speakers and the topic followed by request to the members to present their papers. After the speaker completes the presentation, the chairperson presents in brief the main points covered by that speaker and clarifies the procedure for interaction/discussion. Thus during the seminar session, the chairperson act as initiator, motivator, facilitator, elaborator and controller.

A detailed report on the seminars conducted throughout the year can be prepared by seminar committee and can be submitted to the evaluation committee for necessary follow up action.

Some example of seminar topics are 1. Supernova, 2. Superconductivity, 3. Structure of solid, 4. Earthquakes, 5. Aid, 6. Environmental protection, etc.

Use,

1. The person delivering a seminar gets a better and thorough understanding of the topic chosen by him during the preparation, delivery and post seminar discussion.
2. With much freedom of expressions, he develops his personality and qualities like public speaking, communication skills, etc.

Thus, a seminar goes a long way in nurturing the talent of the participants.

Panel discussion

The themes or topics of every complex / controversial nature are considered for panel discussion. It is a lively activity in which the participants are given a topic for discussion. Each of them is helped and guided by a moderator or facilitator. One / of the science teachers can act as a moderator. A simple topic is given for all the participants. Usually five or six participants may carry on this activity with the help of a moderator. Each of the participants is given a fixed time, say 7 or 10 minutes depending on the topic.

A particular day in a month may be fixed for panel discussion and should be informed to all members i.e. regarding the names of participants, time, date and venue.

The moderator initiates the discussion, and helps the participants who is unable to discuss or put forth his idea, effectively. The moderator is responsible for making the discussion viable and should see that each participant is given ample freedom to put forth his ideas in the discussion. He briefly introduces every participant to the others. He should be docile and should have essential qualities like patience and tacitfulness. After completion of the speech of a participant, the other participants may raise questions. In this process of answering the question, the moderator acts as a bridge between the participant to whom the questions are put and the other participants. He also summarizes the key points and highlights the learning points. The topic chosen for this activity may or may not be related to the syllabus.

The science club can also invite members of other club, from different schools for panel discussion. An inter-school discussion can also be arranged.

Uses

1. Every participant gains much knowledge and understanding of a topic on the principles of 'learning from one another'.
2. The characteristics essential for a student of science viz. scientific attitude and scientific temper are developed to a great extent through this activity.
3. A participant strengthens his socialisation through group-interaction.
4. It helps to develop critical thinking among all participants.

Some topics such as radio active fall out, health and hygiene, pollution, our earth care and share, acid rain, etc., can be selected for panel discussion.

A detailed report on the different panel discussions can be prepared and submitted to the evaluation committee for further follow-up action.

Symposia

It is an activity in which a topic is divided into various sub-topics and each sub-topic is allotted to each participant. A fixed duration of time 5-10 minutes is given for each participant. The sub-topics taken up for the activity are arranged in a logical sequence. Full freedom is given to each participant to put forth his ideas or the facts related to the sub-topic.

Organisation

The seminar sub-committee plans and organizes this activity. The symposium can be conducted in every alternate month. But it should not fall in the month in which panel discussion activity is carried out. This activity is not a competition. Before the symposium begins, an introductory speech can be given by the chairman (one of the science teachers or even a non-participating and active student member). He/She also regulates the proceedings. At the end of the symposium the same teacher or the student i.e. the chairman may sum up the important points of the theme/topic put forth by the participants.

The topics, sub-topics and the date of the activity should be announced well in advance so that the participants can prepare themselves for the activity. A science club can invite the members of other science clubs of different schools to participate in symposia. These types of inter-school symposia can be conducted once or twice in an academic year. A detailed report on different symposia can be prepared and the same can be submitted to the evaluation committee for further follow-up action.

Uses

1. Each participant is given an opportunity for specialisation of a sub-topic.
2. He is given a chance to get to know about the latest and innovative ideas if any related to the sub-topic.
3. The participant develops communication skills and quality of public speaking.
4. He is exposed to get knowledge of other sub-topics related to the single topic.

Some themes/topics for symposium are as follows :

1. Energy
 - i. Types of energy
 - ii. Conservation of energy
 - iii. Sources of energy
 - iv. Conversion of one form of energy into the other forms.
 - v. Non-conventional sources of energy and their importance.

2. Periodic table

- i) Need and history of Periodic table
- ii) Classification of elements - s, p, d and f block elements.
- iii) Periodicity of atomic properties
- iv) Unique properties of elements
- v) Uses

3. Endocrine system

- i) Types of endocrine glands
- ii) Different hormones secreted by the above glands
- iii) Action of hormones
- iv) Hormone defects and cure

Olympiads

It is an activity in which the students, may be around 20, will be administered written test of objective type in many rounds. In each round of the test the questions of the same level are asked and fixed time is given to all for answering. After scoring, the students are eliminated who failed to get the percentage that is fixed by the convenor say 60% for that round. In every round the percentage may be changed according to the difficulty level of questions. The questions of knowledge, understanding and application level may be asked in each round separately and elimination is done accordingly. This process is continued till most of the participants are eliminated except 2 or 3 who will be declared as winners at the end.

Organisation

The seminar committee can plan and organize this activity.

An assembly hall or any spacious room can be chosen for carrying out this activity. If this is not feasible, a classroom itself can be used for this purpose. This activity can be conducted twice in an academic year with a gap of say three months between the two events. The details of the activity like the list of topics to be covered under the olympiad, time and venue should be announced well in advance so that ample time is there for the participants to take part effectively.

Uses

1. The talented students can be identified through this activity.
2. The participants are given an opportunity for independent study of various topics/concepts to be covered in the olympiad.
3. We can develop scientific and independent thinking among the students.

Examples

Examples of some questions are given below.

1. What does Newton's third law state?
2. If two concurrent forces are equal and opposite, what happens to the point of concurrency?
3. Two equal and opposite forces act on two different objects one after the other, can we call these as action and reaction forces? Justify your answer.
4. Can frictional force offered by a surface act as reaction force? Explain briefly.
5. Five similar one rupee coins with mass ' m ' are placed one above the other. What is the force exerted by the third coin on the fourth?

Type of questions

The questions can be related to one or more topics. This activity can be classified for juniors consisting of classes V to VIII or V to VII and seniors consisting of classes VIII to X or IX to XII as the case may be. The questions are chosen/framed very carefully taking in view of the level of the participants.

A detailed report on the different number of olympiads conducted during the academic year can be prepared by the seminar sub-committee and can be submitted to the evaluation committee for follow-up action.

Collection and Preservation

The collection of animals, plants and other materials can be done during field trips or as a routine practice and they can be preserved properly in the laboratory/museum/aquarium/classrooms for further study/observation.

Brief outline of methods of collecting and preserving animals

	Location	Special Collecting Devices	Methods of Killing	Fixative	Preservative
Fresh water snails	On fresh water (attached to branches and submerged wood) during mid summer.	Flat bladed knife or scalpel	70% alcohol	70% alcohol	70% alcohol
Hydra	Canals, tanks, rivers, lakes (attached to vegetation, stones, fallen leaves).	Flat bladed knife or scalpel and pipette	Narcotised by menthal and	Bouin's solution	70% alcohol
Fresh water planarians	Fresh spring-fed streams, tanks, canals.	Fresh liver placed in water where planaria are found.	Extend on glass slide and submerge in hot Gilson's solution.	Gilson's solution	Formalin alcohol
Larger animals	Intestines of dog, cat, rabbits, sheep.	Scalpel and forceps	Relax in cold water, wrap animals' around. Support to stretch them and immerse in 10 formalin.	Bouin's solution or Formalin	Alcohol or formalin
Ascaris	Intestines of pig, horse, cat or dog.	Scalpel and forceps	Dip momentarily into 98°C water.	5% formalin or saturated corrosive sublimate	5% formalin
Aquatic snails	Canals, tanks, streams, ponds, lakes, most abundant among vegetation	Dip net, net scraper	Anesthetize in warm water by adding Magnesium sulphate causing them to expand, then drop into 10% formalin	10% formalin	8% formalin
Planarians	Streams, lakes, tanks, and canals.	Nets or hook or fishing rod	Drop into concentrated formalin /inject formalin into body	10% formalin	8% formalin

Animal	Location	Special Collecting Devices	Methods of Killing	Fixative	Preserved
Frog	Frontal down or border of marshy lakes	Net	Inject ether into body cavity or drop into 80% alcohol/ Anaesthise by chloroform.	Inject 5% formalin into body and place in 5% formalin	5% formalin
Frog eggs	Shallow water of ponds in early spring	Jars	Place in fixative i.e. 8% formaline.	8% formalin	8% formalin
Reptile	Wooded fields	Nets	Inject ether and drop into 70% alcohol	10% formalin	10% formalin
Birds Small medium	In many places	A 12 gauge shot-gun & shells with fine shot	Birds skins are most generally used study or reference. Internal parts body are removed and skin dusted with arsenic powder and then stuffed with cotton and dried.		
Large mammals	In many places		Gas or drowned if taken to laboratory alive/chloroform.	Inject 8% formalin into body and large muscles	8% formalin

Requirements for collection of specimens

1. Glass bottles/jars with perforated caps
2. Polythene bags
3. Forceps
4. Surgical gloves
5. Glass slides
6. Buckets
7. Magnifying glass
8. Net

List of suggested animate and inanimate things to be collected for preservation

Plants : Different plants, leaves, flowers, seeds, cones, etc.

Animals : Different animals (like reptiles, frogs, fishes, starfishes, spider, etc.), organs (brain, heart, lungs, corals, embryos, parts (horns, shells, teeth) of animal nests, eggs, etc.

Other things : Rocks, minerals, fertilizers, fibres, stamp coins, photographs of scientists, paper cuttings related science, implements, etc.

Precautions

1. Care should be taken not to disturb the habitat.
2. Replace dead wood, stone, rocks etc. after turning over.
3. Many stones or shells should not be picked up as they are required by the soil as nutrient for plant growth.
3. Distance should be kept from poisonous animals.
4. The collection of specimens should be from both fauna and flora.
5. Collection should be limited otherwise it upsets the environment.

Simple preservation techniques

1. Dry preservation : shells, bones, starfishes, urchins, insects can be dried well and stuffing of birds can be made and stored.
2. Wet preservation : The following wet preservation methods are used.
 - a) Brine method
Soft bodied animals like hydra, snail, earthworm, crab, fish etc. can be preserved in brine.

How to make brine ?

To a bucket full of water, add common salt till there is saturation i.e. keep on adding salt till the salt remains undissolved.

- b) Formalin method
 - i) To 5-10% formalin add 3 parts of water carefully and stir gently.
 - ii) Fill three fourths of the glass bottle with this formalin solution.

iii) firmly attach the specimen to a glass plate and immerse it in formalin solution.

Preparation of certain fixatives.

1. Ethyl alcohol (70% solution)

This is a common preservative for small forms and tissues. It is made by adding 25 ml of water to 70 ml of 95% alcohol.

2. Bouin's fixative

This is a good fixative for both animal and plant tissues. Its main advantage is that the specimens may be stored in it for long period of time. Mix 5 ml of glacial acetic acid and 25 ml of 40% formaldehyde with 75 ml of saturated aqueous picric acid. Leave the tissue in the fixative for 24-48 hours, then wash it with 70% alcohol until the colour is removed.

3. Carl's solution

Carl's solution is an excellent preservative for insects. A small amount of glycerine is added to the solution when preserving hard bodied insects. This will stop them from becoming brittle in the preservative. The solution is made by combining ethyl alcohol (95%) 170 ml, formalin (40% formaldehyde) 60 ml, and water 280 ml. Before using it 20 ml glacial acetic acid is added to the solution.

Techniques for preserving plants

Preservation of green plants

FAA solution prevents the bleaching of chlorophyll in plants. To FAA add enough copper sulphate to make a saturated solution.

FAA solution can be prepared by combining the following materials.

Ethyl alcohol (95%)	- 50 ml
Formaldehyde (40%)	- 10 ml
Glacial acetic acid	- 2 ml
Distilled water	- 40 ml

Preservation of plant parts

1. Collect the flowers with a few leaves and place them in castor oil for 24 hours.
2. Wash the flowers in xylol for three hours to remove the castor oil and to make the plants soft.

3. Keep it in plastic cloth. Thus the plants are protected from peeling and would last for several years retaining their natural colour.

Herbarium Technique

1. Each plant should be arranged in such a manner that all its parts are seen, then they are clearly placed between sheets of paper and pressed with a weight.
2. When perfectly dry each plant should be mounted on a sheet of white paper.
3. The plant should be fixed in position by a few narrow strips of paper gummed across the stem and leaves.
4. Each herbarium sheet should carry full details of family, genus, species, location and the date of collection.

Science Corner or Question Box

Science corner can be established as one of the activities of the science club which will be not only interesting but also informative and educative.

Special features of science corner

1. To provide opportunity to students for posing questions which could not be discussed elsewhere.
2. To provide opportunity to students to answer questions pertaining to science which could be imaginative and creative.
3. To develop original thinking among students.
4. To supplement classroom subject learning.

Establishment/Organisation

1. A suitable and secured place preferably near laboratories or science club room may be identified for the science corner.
2. A wooden or metal box with locking system and provision for inserting the papers with questions/answers may be placed on a suitable table/attached to the wall.

3. A student member of science club may be identified to look after the science corner i.e. collection, scrutiny, filing, display and compilation.
4. The teacher incharge of science club/any teacher/member of science club may look after evaluation and maintenance.
5. Two types of activities can be performed in a science corner.
 - i) Questions from the students - students (both members and non-members) may be advised to write questions on paper-clips and put in the question box. Questions or doubts which could not be discussed in classrooms or questions which need scientific information may be asked. Anonymous questions can also be answered. The incharge student member may sort out the questions and obtain answers from concerned staff members. The answers may be displayed on science wall magazines or can be read out in school assembly. No question should be left unanswered. The teacher incharge should make necessary arrangements to obtain answers for all questions as far as possible.
 - ii) The teacher can also pose questions to obtain answers from the students. This can be done either by reading the question in school assembly or placing on the wall magazines. The students may place the answers in the question box. The incharge student member may sort out the answers and the teacher incharge or any teacher member may evaluate them. The best answers may be read out in school assembly or can be displayed in bulletin boards and later may be rewarded.

Special talks

In order to break monotony of the every day school teaching, extension lectures can be arranged from time to time.

Organisation

1. Topics related to the level of the science club members should be chosen.
2. Experts can be chosen from neighbouring university, institutions, hospitals, engineering colleges, etc.
3. The teacher in charge could personally go and invite the distinguished experts at their convenience and inform the children and authority in advance.

4. A room (classroom) equipped with the black board and adequate furniture may be arranged.
5. Time duration could range from 1 - 1 1/2 hours.
6. After the delivery of the lecture, selected group of children may be allowed to interview these experts. By this the students get across to many more such distinguished personalities. The extension lectures may be arranged on the topics like i. Aids, ii. Genetic Engineering, iii. Chemistry in daily life, etc.

Expert lectures could be conducted once in six months.

Uses

Children get exposed to more details to widen their knowledge of science.

Celebration of scientist's birthday

This activity should be highlighted to make children become aware of the names of the various scientists and their discoveries.

Organization

1. A brief talk on their contributions to science could be given during the morning assembly.
2. Charts and pictures related to their latest discoveries and their contributions to science could be displayed.
3. Quiz, symposiums or debates may also be conducted.

Some scientists' birthdays such as Michael Faraday Day, Charles Darwin Day, Sir C V Raman Day, etc. may be celebrated.

Celebration of wild life week

It is a known fact that over the past few decades many species of plants and animals have become extinct. So in order to highlight the need for preservation of wild life, the wild life week must be observed in the school as a part of science club activity. Children must be enlightened about the need of tree plantation, may take up plantation of trees sapling and also observe the Vanamahotsava day. Certain activities like projection of films, tableau, skits, special talks, debates, etc. may be conducted during this day.

First Aid

First aid is the precautionary measure taken up by the people around to the injured to keep him/her safe until the arrival of the doctor to the place. The members of the science club should be trained in first aid so as to help them as well as others before a doctor attends them.

First aids for different types of accidents/injuries.

1. Fire

Fires are caused by different means. It may be due to open chemicals, oil or due to some short circuit in the supply of electricity.

If a person catches fire, he should be wrapped up in a blanket so that the air supply would be cut off. Cold water should immediately be poured on the burns so that further disintegration of the tissues could be stopped.

If a house catches fire the doors and windows should be kept closed, much water should be used to extinguish the fire or a fire extinguisher can be used.

If some inflammable substance gets ignited in a beaker or a flask, an asbestos plate should be placed on its mouth.

Fire due to oil or chemicals could be put off with large quantities of sand.

If the fire is due to short supply of electricity the source of supply of it should be cut off.

2. Burns

For small burn sterilized cotton pads soaked in sodium bicarbonate solution should repeatedly be applied over them. Sulphonilamide cream could also be used. In case of large burns special medical advice should be sought.

Acid burns are to be washed with large quantities of water and with mild alkali. Tannic acid may be applied finally.

Alkali burns are to be washed with acetic acid solution or lemon juice.

3. Eye injuries

These may be due to acids or alkalies or may be due to some solid particles.

In all the cases the eye should be washed with pure water. But it is always better if the attendance by an eye specialist is sought for.

4. Poisoning

In all the cases of poisoning, medical attendance by a doctor is advisable and should be sought for.

Types of poison	Example	Remedies
Congruity	Acids & alkalies	White part of eggs or milk, rice water should be given. Purgatives should be avoided
Lethal	Arsenic and phosphorous compounds	A tumbler of water with a spoonful of common salt or mustard oil should be given for vomiting.
	Gas poisoning	Fresh air must be supplied, clothes should be loosened, artificial respiration should be provided if necessary.

5. If the nature of poison is not known

Then a mixture of activated charcoal, magnesium-oxide and tannic acid at the ratio of 2:1:1 should be administered which is a general antidote.

6. Snake and scorpion bites

The medical attendance of a specialist doctor is advisable. Anyhow a tourniquet is to be tied without causing much harm to the tissues of that place. A small cut may be made to run out all the poisoned blood. In the case of a scorpion bite potassium permanganate and citric acid (1:1) should be placed on the place of bite and a drop of water is to be placed on it. The toxicity reduces to some extent.

7. Fractures

Should be attended to by a specialist. But a few precautionary measures could be taken up so as to minimise the damage done to the tissues or the loss of blood etc. A suitable bandage may be tied. Stoppage of outflow of blood must be attempted to by simple techniques such as simple pressing, applying bandage, etc.

8. Drowning

The drowned person generally take in water. It should be driven out by applying pressure on the stomach. Artificial respiration should be given through mouth. The clothes should be loosened.

9. Cuts

In these accidents, stoppage the bleeding is essential. A Lorniquet or digital pressing as the case may be should be administered in the case of artificial bleeding. In the case of a venous bleeding, light pressure using a narrow bandage on the distal part of the wound will be more useful. Minor cuts can be disinfected or bandaged.

10. Cleaning wounds

Cleaning of wounds should be done by antiseptic lotion. Any foreign matter should be removed by tweezers or by vacuum. A solution of 1:10 dettol acts as an antiseptic solution. Sterilized dressing should be applied. Large wounds should be attended to by a specialist only and minor cuts could be treated with tincture of iodine on a pad of cotton.

Demonstrations

The demonstration is defined as the act of exhibiting with explanation of the operation or use of a device, machine, process, product or the like.

From simple thing like cutting of a paper to a complicated study of the satellite comes under the purview of demonstration. But it is advisable to organize needbased, interesting and novel demonstrations under science club activities.

Lack of sufficient equipment and the availability of local resources demands the demonstration. Individual differences, diversified vocations, variation in expertise, advancement in new techniques and devices etc. are the pivotal supporters for the demonstration. It concretises the learning and helps in economy of materials, time and energy.

Based on the nature of the demonstration, one can classify them as,

- 1) Related to subject - Demonstration related to a topic of the syllabus of any class.

2) Fun demonstrations Demonstration of games and magic related to science.

3) Skill demonstrations Demonstration of an improvised working model, preparation of toy using waste materials, dissection of animals etc.

4) Operational demonstrations Showing and explaining the operation/use of a novel machine, tool, device, etc.

Organisation

The time, date, venue, duration, the particulars of the demonstrator, the type of demonstration etc. should be informed to all the members of the club and to the special invitees well in advance.

The time may be fixed during the school hours or after the school hours based on the convenience of the demonstrator and the club members.

The demonstration may be carried out in the classroom, in the laboratory, in the school garden, in the field or any other suitable place.

The demonstrator(s) may be an insider like a member/group of members of the club or a teacher or an outsider like a pupil from other club/school or a teacher from other school or an expert in specialized field of science.

Prearrangement and well made rehearsal is the prerequisite for the demonstration. It should be visible and audible to every observer/participant. The explanation of the demonstration must be clear, concise and brief.

All the audience participation makes the demonstration more successful. So the demonstration should not be 'touch me not' type but it should be 'handle me and help yourself' type. Evaluation should be done during/after the demonstration. The frequency of the arrangement of demonstration may be once in a week.

For good demonstration, the following key points may be kept in mind.

1. Setting the tone for good communication.
2. Keeping the demonstration as simple as possible.
3. Not deviating from the main idea.

4. Checking continuously that demonstration is being understood
5. Not hurrying the demonstration
6. Not dragging out the demonstration.
7. Summarizing as the demonstration goes on.

Examples of some of the demonstrations

1. Centre of gravity toys
2. Bernoulli's principle
3. Combined pulley
4. Candle power
5. Use of computers
6. Biode
7. Velocity of sound
8. Ohm's law
9. Photosynthesis
10. Germination of seeds
11. Rate of reactions, chemical equilibrium
12. pH value
13. Preparation of soap
14. Preparation of gases and their properties
15. Soil analysis
16. Improvisation of working model of a motor
17. Transformer
18. Epidio rope
19. Overhead project
20. Science kits etc.

Improvised models and apparatus

In our country most of the schools have no laboratory. Science cannot be taught without demonstration to impart knowledge effectively. Buying the apparatus for the laboratory is a costly affair. Therefore, the teachers have to improvise some apparatus with low cost materials available. They can seek local help to gather such materials. Improvisation also can be done by utilising the skills of the interested students of the science club.

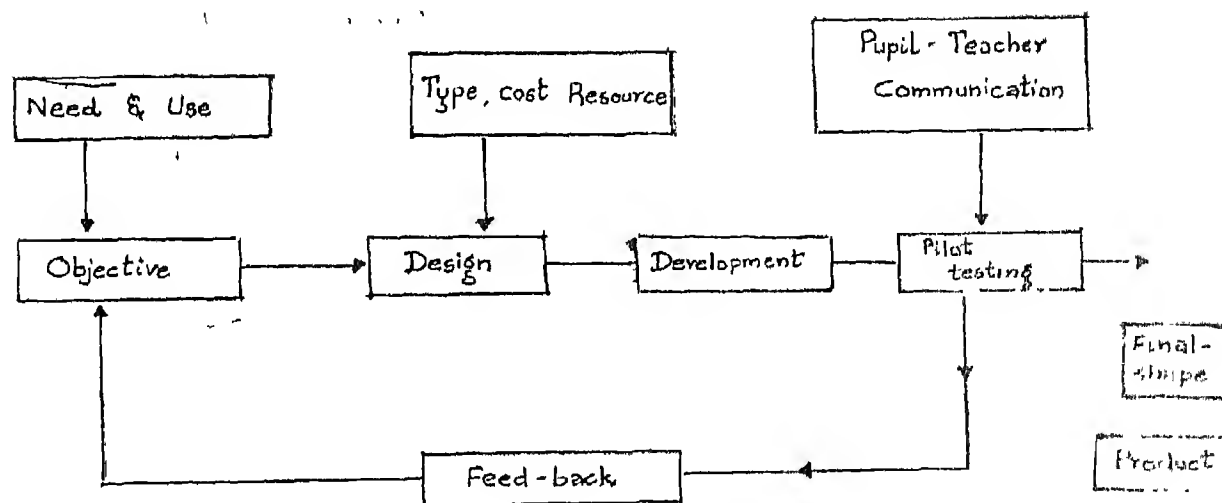
Interested students may be selected to form a committee to implement improvisation work. A science teacher shall guide the committee to organize improvisation.

To make some apparatus, small tools such as hammer, cutting plier, saw, screw driver and so on are required. Science club should finance the purchase of some of the tools.

In improvisation the following points shall be kept in mind.

1. Need and importance
2. Objectives for which improvisation is to be done
3. Type, cost, available resources
4. Design
5. Pupil - teacher consultation
6. Development
7. Pilot testing
8. Final shape
9. Product

Schematic representation to improvise an apparatus.



The committee shall plan to improvise keeping in mind the objectives and the resources available. They have to put enough thought for proper designing of the improvised model/apparatus. Then the teacher and the student members develop the apparatus carefully. After assembling the parts, they have to do the pilot testing. If teacher is satisfied, then he shall allow the members to go on with their work to give final shape. After shaping the product of improvisation, they can be used or demonstrated to the club or class.

In selection of materials, the following points are to be kept in mind.

1. The raw materials easily available and also available in low cost in the local environment are to be selected.
2. The materials that can easily and effectively be used by the teacher to achieve the objective may be selected.
3. The materials that are simple, accurate and appropriate to design may be selected.

The following materials can be used for improvisation.

1. Pieces of wood
2. Iron strapping
3. Blades
4. Nails
5. Cycle spoke
6. Needles
7. Pins
8. Tin cans
9. Iron wire
10. Broom sticks
11. Match sticks
12. White paper
13. Glass
14. Broken glass wine
15. Clay, etc.

Kind of improvisation

Improvisation can be of two types.

1. Static models.
2. Working models

Some examples of static models

i. Digestive systems, ii. eye, iii. skeleton, iv. ear, v. skin, vi. models of atomic structure, vii. structure of different molecules, viii. blast furnace, ix. models of solar system, etc.

Some examples of working models.

i. Pulling bell, ii. Telescope, iii. projector, iv. periscope, v. gold leaf electroscope, vi. model showing working lungs, vii. microscope

List of some improvised models/apparatus

Physics:

1. Electric bell
2. Apparatus to show that liquids keep their level
3. Galvanoscope
4. Magnetic boat
5. Kaleidoscope
6. Newton's colour disc
7. Periscope
8. Ripple tank
9. Projector

Chemistry :

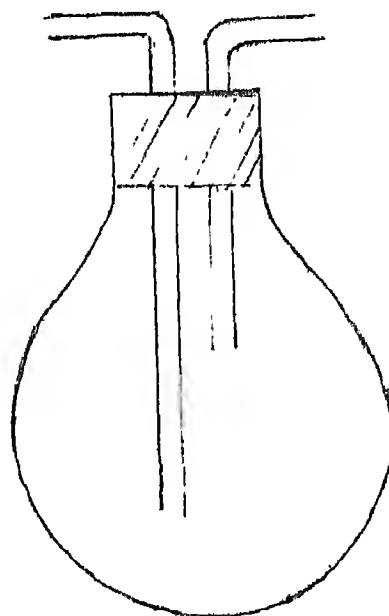
1. Fire extinguisher
2. Model of atomic structure
3. Test tube stand
4. Tripod stand
5. Tyndall's apparatus
6. Structures of some molecules

Biology :

1. Model of plants and animals made of clay, plaster of Paris, cardboard, soap, etc.
2. Photometer
3. Preparation and maintenance of aquarium, vivarium
4. Respirometer

Procedure for improvization of some of the model./ apparatus

1. Wash bottle



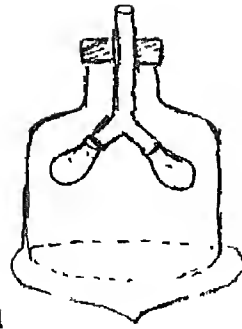
Materials required

- a) Fused bulb
- b) Two-holed rubber or wooden cork
- c) Two rubber tubes

- i) Fused bulb may be fixed with two holed rubber stopper.
- ii) Two rubber tubes may be arranged as shown in the figure.

2. Breathing

Fig. 2



Materials required

- a) Bottled bottle (bottom opened)
- b) Glass or rubber tube
- c) Three balloons

- i) Fix two balloons to the tube (Y shape), insert the tube through the hole of rubber stopper.
- ii) Tie big balloon to the bottom of the bottle.
- iii) Fix the tube in the bottle using one hole rubber stopper.

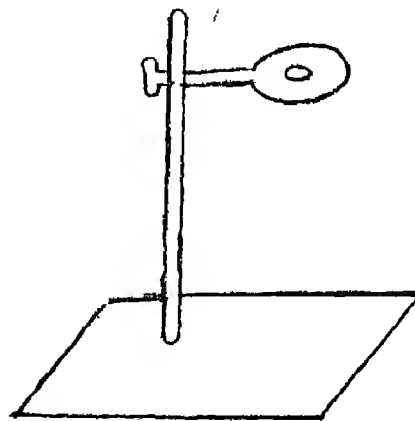
If big balloon is pulled downwards air enters into the small balloons.

If big balloon is pushed upward, air goes out of the small balloons.

The expansion and contraction of the two small balloons demonstrate the working of lungs.

3. Water drop Microscope

Fig. 3

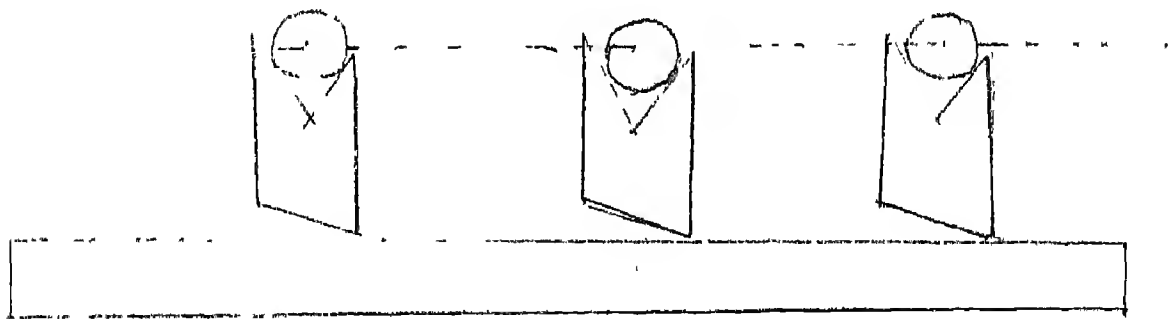


Materials required

- a. 6" x 3" x 1" wooden base
- b. A thin plate with a small hole
- c. 5" x 1" x 1" wooden piece to hold the plate

The 5" x 1" x 1" wooden piece is fixed on the base to form a stand. The plate with the hole should be fixed in such a way that it can move up and down. A drop of water placed on the plate acts like a lens and simple microscope is constructed.

4. Telescope



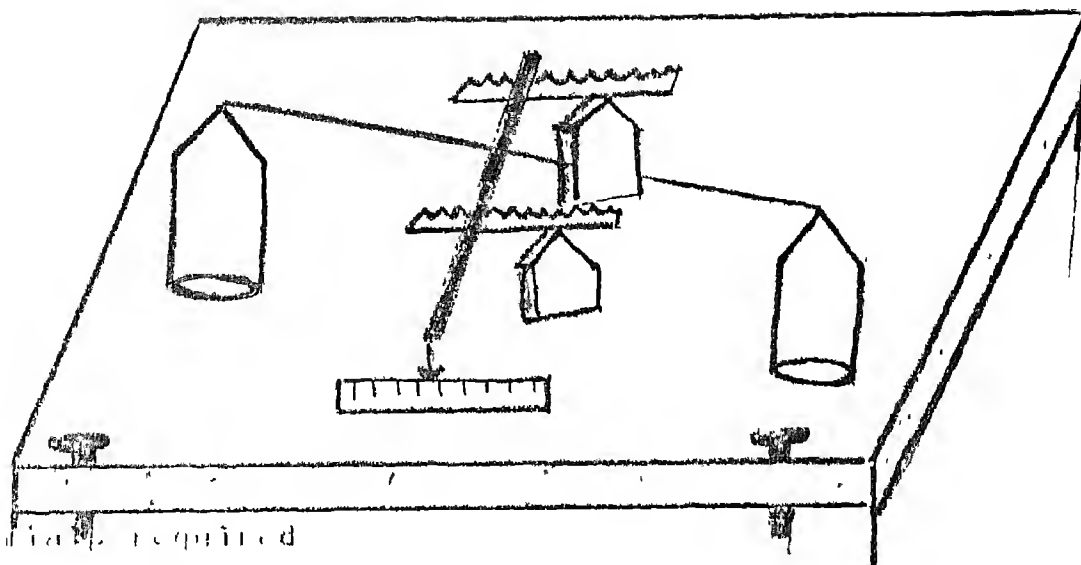
Materials required

- a. 1"x1"x6" wooden scale
- b. 3 lens stands
- c. 3 convex lenses
- d. Iron strap

Fix the convex lenses on V stands so that they can move on both sides. By adjusting the lenses, the telescope can be constructed.

5. Simple Beam Balance

Figure



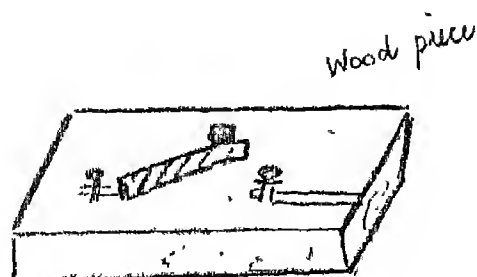
Materials required

- a. 1", 4", 10" wooden piece for base - one
2. 1" x 3" x 7 1/2" wooden piece for stand - Two
- c. 1/2" x 1" x 2" - wooden piece for scale - one
- d. Two cycle spoke,
- e. One large sewing needle
- f. One razor blade
- g. Iron strip for indicator
- h. Tin pieces for pans
- i. Two bolts for level adjustment (3/4" x 1 1/2")

If the two wooden pieces are erected on the base. Two thin pieces are fixed on the wooden pieces. Cycle spoke may be used as a beam. Pans have to be hanged as shown. Iron strip may be used as an indicator. A horlicks bottle can also be used as the base for free suspension of the beam.

6. Switch

Figure

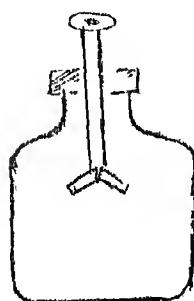


Materials Required

- a. Wooden base $1\frac{1}{2}" \times 2" \times 3"$
- b. $3\frac{1}{4}" \times 1\frac{1}{2}"$ two bolts
- c. Iron strip
- d. Small piece of wood

Fit two bolts with double washers at a distance of $1\frac{1}{2}"$, iron strip having wooden piece is fixed at one end. The other end should move freely. Both the bolts have to be connected with wires. If the strip is pressed, the circuit is completed.

7. Gold leaf electroscope



Materials required

- a. Horlicks bottle
- b. Cycle spoke
- c. Thin aluminium foil taken from the cigarette box
- d. One holed rubber cork

Horlicks bottle is closed with wooden cork. Cycle spoke is bent L type at one end. The screw may be used at head. Aluminium foil is bent shape and put on the spoke.

8. Model showing structure of an atom



Material required

- a. Cycle pole
- b. Some wooden piece
- c. Bamboo stick or wire
- d. Seed of different colour

Bamboo stick or piece of wire are bent as shown in the figures with different radii. They should be arranged on the cycle pole. Wooden pieces are arranged on the bamboo stick or the wire as shown.

Food can be used to represent electron.

Use material like paper and other paper product. You can bend into pulp. The pulp can be moulded into a required model. They must be allowed to dry up and then painted.

Model can also be prepared using clay. It has to be used to avoid break after drying. China clay also can be used for the same purpose. Soaps can be carved in, to prepare many model.

Science exhibitions and Science fairs

The scope of the exhibition/science fair should be decided clearly i.e. whether to limit to the school or open to other schools and public, type of exhibits, activities and programme, etc.

Objective

1. To encourage students to lay out their ideas and apply them in classroom learning for creative work.
2. To provide opportunity to the student to witness the achievement of their friends and thereby to stimulate them to plan their own project.
3. To popularize science activities among greater number of students and public.
4. To encourage public interest in science and scientific skills.
5. To encourage critical thinking in the design and development of apparatus for various investigation.
6. To develop healthy competition among participating students.

7. To familiarize with the changing process of scientific ideas, inter-relationships, etc.
8. Integration of scientific ideas related to daily life situations.
9. To provide stimulation for scientific hobby/pursuits.

Planning

The teacher in charge should form a central committee with the help of head of the institution. The central committee forms sub-committees to take up various aspects of exhibition such as publicity, source of finance, execution, judgement, etc.

Exhibitions are of various types such as

1. General exhibitions Eg. Science exhibitions
2. Thematic exhibitions Eg. Water and Man
3. Temporary exhibition housed in temporary structure for few days (Short duration exhibition)
4. Permanent exhibitions housed in permanent structure/ building and campus (long duration exhibition)

The science club should decide the type of exhibition to be organized and plan accordingly. During organization of an exhibition, the main theme and sub-theme have to be decided.

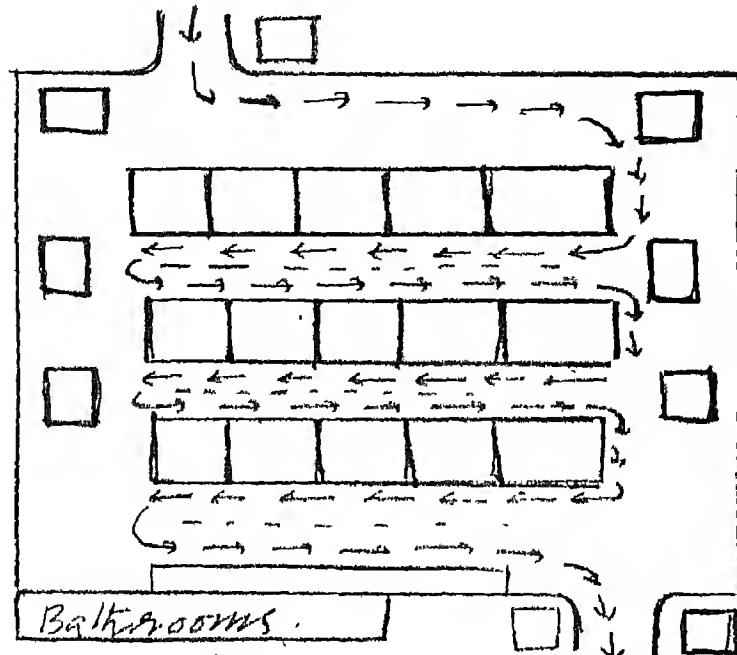
Example 1. Main themes : Food and Man
 Sub-theme : Food production
 Food preservation
 Food distribution
 Food processing
 Types of foods, etc.

Example 2. Main theme : Rates of reactions
 Sub themes : Slow and fast reactions
 Explanation of rate of a reaction with suitable examples.
 Factors affecting the rate of a reaction etc.

The date and timing have to be carefully selected for the exhibition and science fairs. Enough time should be provided to the students and the public to visit science fair/exhibitions and view the exhibits. The duration and frequency of the exhibition should be decided many days in advance. Sufficient time must be provided to students for planning, arrangement, display and cleaning.

The site of exhibition/science fair has to be decided in advance by the committee. Necessary permissions have to be obtained. A flexible plan must be prepared showing entry, exit, path and specified areas for various items.

Example



The expected expenditure, source of income, allocation of funds should also be decided in advance. The dates, timings, venue and duration of exhibition have to be publicised through various media (pamphlets, posters, display boards, circulars, newspapers). A tentative list of exhibits should be compiled to determine how much space and how many boards would be needed.

Proper provision for first aid must be made to meet all the and proper safety measures have to be ensured. Proper arrangements must be made for waste disposal, sanitation, water supply, furniture, electricity, etc.

Organisation

Distribution of work

After planning, the work should be assigned to different individuals or groups. Different groups would look after different programmes such as advisory, executive, recording, reception, general management, seating, publicity, discipline, refreshments, material transport, display, etc.

Execution

Different committees would execute the planning of the fair/exhibition. The fair/exhibition may be inaugurated by some important persons of science. Preferably the selected students should be made incharge of various

experiments/model and they should give full explanation of the exhibits. The exhibition/fair should start on announced day and time.

Some points are mentioned below for effective display of exhibit.

1. Display should be eye-catching and attractive.
2. Display should be simple, self explanatory. Use of unnecessary decorations to be avoided.
3. Lettering should be large and simple. Titles should be short and narrative and should be brief. Long written descriptions should be placed in folders.
4. Each entrant should be given the needed amount of space in which the project/experiment to be set up.
5. Projects requiring such things such as water, electricity or sunlight should be allotted suitable places. Chemistry experiments involving evolution of suffocating gases or darkness should be allotted suitable places.
6. Exhibits of same category should be placed together.
7. Uniform furniture should be used to display the exhibits.
8. Effective use of light should be made.
9. Name and class of the student should accompany the exhibit.
10. No exhibit should be left unattended to.

Management

1. Problems in execution and transportation during display have to be tackled.
2. Discipline has to be maintained.
3. Volunteers have to be looked after carefully.
4. Any untoward incidents must immediately be brought to the notice of teacher in charge.

Follow up activities

Evaluation and Judgement

1. The Fairs/Exhibitions should be judged by different panel(s) of judges. The judges can be chosen amongst the individuals in the community specialists, teachers having some background of science, related top the theme, etc.
2. Judging may be based on scientific approach, originality, technical skills, explanation and creativity. Criteria for judgement should be given to the judges well in advance.
3. Judging criteria should be made well known to the participants in advance.
4. After the fair/exhibition is over, the teacher and the students should evaluate it and find out whether the objectives of the fair have been achieved or not.
5. Judgement should be fair and secret.

Opinion gathering

It is advisable to collect opinion polls of visitors. A separate note book may be placed at the exit and a student representative may look after it.

Preparation of souvenirs

A souvenir may be prepared and released with the list of exhibits and their scientific importance. They can be used as reference for future exhibitions.

Write up /Assignments

Participants may be advised to submit write-ups and assignment on exhibition and science fair.

Preservation of exhibits

The displayed exhibits may be placed in science museum and preserved.

Example, of some exhibits

1. Electrical locking system
2. Signal gate
3. Solar water heater
4. Rain indicator
5. Hydraulic pump
6. Door alarm

7. Calling bell
8. Mini computer
9. Flood alarm
10. Gas generator
11. Automatic water tap
12. Gravity transport
13. Magnetic train
14. Traffic controller
15. Telescope
16. Microscope
17. Robot
18. Rheostat
19. Bio-electricity
20. Insecticide sprayer
21. Pollution to model
22. Skeleton
23. Life cycle of organisms
24. Heartbeat by Kymograph
25. Aquarium
26. Vivarium
27. Working models of human systems
28. Hydroponics
29. Vegetable carving
30. Poor man's refrigerator
31. Poor man's water cooler
32. Smokeless chulha
33. Brain of animals
34. Human embryo
35. Seed collections
36. Insect collection
37. Fish collection
38. Diseases
39. Vitamins
40. Soft drinks
41. Medicinal plants
42. Chemical Aquarium
43. Volcanic eruption
44. Dye
45. Candle preparation
46. Display of various metals and ores
47. Improvised models/apparatus
48. Display of crystals
49. Low cost leaching aids
50. Water filler
51. Poor man's thermos flask
52. Luminescence experiment

Gardening/Plantation

Objectives

1. To acquire knowledge of techniques of cultivation, duration of crops, seasonal variations, etc.

2. To inculcate dignity of labour.
3. To utilise the land at maximum.
4. To develop aesthetic value.
5. To use the garden as an open laboratory for teaching concepts.
6. To use the scientific knowledge in garden practices.

Organization

1. A teacher incharge should plan the school garden well in advance considering various factors such as security, facilities, finance, availability of implements, etc.

Members should be classified into various groups to take up various activities systematically such as levelling, weeding, watering, manuring, security, etc.

2. A visit to the nearby horticultural institutions or agricultural universities may be helpful.
3. The plants to be cultivated have to be carefully decided considering all factors such as availability of soil, pH, water resources, duration, utilization, etc.
4. The teacher incharge can give freedom to the members in selection and cultivation of plants.
5. Proper arrangements have to be made to maintain the garden even in vacations, holidays, during examinations, and class hours, etc.

Suggested plants

- | | |
|--|---|
| 1. Ornamental plants | Eg. Crotons and flowering plants |
| 2. Vegetables | Eg. Tomato, chillies, brinjals, beans, etc. |
| 3. Fruit yielding plants | Eg. Papaya, citrus, guava, etc. |
| 4. Plants required for for taxonomy practicals | Eg. Hibiscus, caesalpinia, tomato, etc. |
| 5. Medicinal plants | Eg. Onion, neem, tulsi, etc. |
| 6. Plants for lawn | Eg. Grasses |
| 7. Plants for fencing | Eg. Lantana |
| 8. Potted indoor plants | Eg. Bryophyllum, money plants, ferns, etc. |

Planning

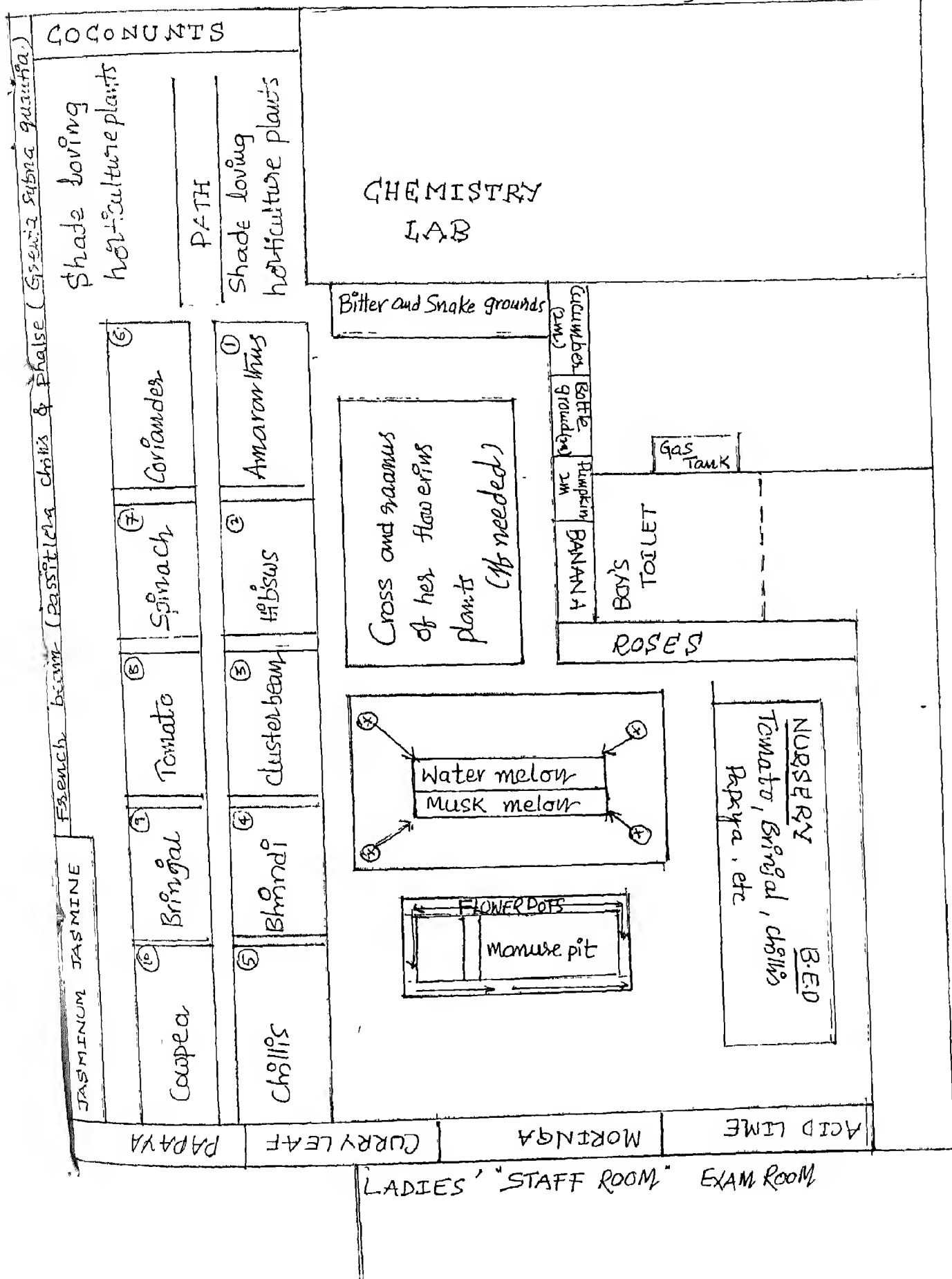
1. A few members may be identified to take up the task and sub-divided.
2. The plots should be allotted to members.
3. The place where the kitchen garden is to be developed has to be decided. Fencing, locking system, water supply and security are important factors to be considered.
4. A lecture on development of nutrition garden by experts is beneficial.
5. A lay-out has to be prepared in advance.
6. The ground should be cleaned and levelled.
7. Decided plots should be prepared by ploughing, manuring, (pit manure) and by mixing with red soil and chemical fertilizer if needed.
8. Salts may be added to the soil if necessary to adjust the pH value.
9. Vegetables to be cultivated should be carefully selected considering the season, availability, need, space and soil.

Establishment of garden

1. The dry beds have to be developed for vegetables which need drip irrigation. Eg. Tomato, chillies etc.
2. Paddy beds can be planned in one corner of the kitchen garden.
3. A manure pit may be dug in kitchen garden for future use.
4. Vegetable seed should be sown or transplanted in specified plot.
5. Watering, weeding, manuring, etc. have to be carried out systematically.
6. Less number of plots and handy vegetables may be selected to begin with.
7. Perennials may be cultivated on south/north direction.
8. Creepers can be cultivated near fencing for support.

A Model Kitchen Garden

Play Ground.



10. Few ornamental plants can also be cultivated if needed.

Marketing/Distribution

1. Vegetables harvested can be supplied on payment basis to teachers/students and the money collected may be used for other science club activities.
2. Vegetable can also be distributed to the students who maintain the plots.
3. Vegetables harvested can also be exhibited before non-members for awareness.

Suggested plants for kitchen garden

- | | |
|------------------|------------------|
| 1. Amaranthus | 14. Bottle gourd |
| 2. Coriander | 15. Bitter gourd |
| 3. Frogcock | 16. Snake gourd |
| 4. Fuli | 17. Ridge gourd |
| 5. Radish | 18. Pumpkins |
| 6. Ladies finger | 19. Musk melon |
| 7. Brinjal | 20. Cauliflower |
| 8. Chilli | 21. Drum stick |
| 9. Tomato | 22. Brinjal |
| 10. Water melon | 23. Curry leaf |
| 11. Green bean | 24. Beans |
| 12. Papaya | 25. Cow pea |
| 13. Cucumber | |

Science club magazines/Hand written books/Newsletters

It is very essential to have day to day knowledge of science for becoming a useful member of the community. So there is need to publish a school magazine, class magazine, newsletter, hand written books etc. on the latest developments of science and technology, scientific principles, practical utility of science in our daily life etc. This activity provides satisfaction for the tendencies of collection, submission, construction etc. and thereby leading to a balanced personality of the members. The members' interests find their expression and satisfaction through the preparation of magazines, newsletters, etc. The preparation of magazines develop the writing, thinking, analysing, correlating, editing and reading abilities of the children. This also helps to improve good hobbies like referring and reading books; and inculcate thought provoking ability, etc.

Planning and Organization

1. Name of any scientist/scientific event/discovery can be used for naming the magazine.
2. An editorial board is to be constituted with senior science teacher as editor. Sub-committees are to be constituted to collect and select the articles, to prepare the magazine, newsletters, etc. to file and preserve them.
3. Magazine is to be prepared annually.
4. The newsletter is to be circulated among all the members if possible or is to be displayed on the bulletin board. It is to be prepared monthly. All the newsletters are to be filed and preserved.
5. If printing or typing is not possible, the handwritten magazine may be prepared.
6. While preparing a magazine or newsletter the following hints may be kept in mind.
 - a. The lettering should be large and simple.
 - b. The title should be short and descriptive and the narration should be brief as far as possible and to the point.
 - c. It is better to use pictures, drawing, and diagrams wherever possible. The name and class of the pupil or the contributor should be mentioned.
 - d. All important help should be acknowledged.
7. The editorial board should give importance for all the branches of science. Variety of articles are to be collected and the articles are to be presented should be well arranged in the order like essays, experiments, stories, experiences, quiz, puzzles, projects, innovations, tips, jokes, etc.
8. Members should be advised against copying or reproducing the material from other sources.
9. Help of drawing teachers or local artists may be taken to make the magazine attractive.
10. Prizes may be given for the best articles.

Utilization of useful articles from waste materials.

1. One of the aims of teaching science is to train the pupils to use their leisure most effectively by catering to their individual interests through a number of activities.

Each member has his own interests and capabilities. These individual abilities can be utilised to produce or prepare some useful articles using waste materials. For this, science clubs should provide the maximum opportunities. This activity provides satisfaction for the tendencies of curiosity, imitation, collection, construction abilities of the member and also work experience.

Planning and organisation

A committee will be constituted to cater to the need of this activity. It will advise to collect and utilise waste materials, preserve them, list out the activities to be done. This activity can be used to improve even small apparatus which can be used for the teaching of science. We can use the materials locally available.

Organised activities

Paper craft, preparation of spirit lamps using empty bottles, preparation of models and toys using waste paper pulp, preparation of wall decoratives, card board craft, centre of gravity models, preparation of manures, preparation of science articles using empty egg shells etc.

Materials required

Plaster of Paris, inks of different colours, old newspapers, vegetables, knife, blade, bamboo strip, empty saline bottles, wax, fused bulbs, tube-lights, etc.

Pursuit of scientific hobbies

Need and importance

Many students wander in their leisure without any aim and some of them spend their time in wasteful dissipation. There is every possibility that they may misuse their leisure and spoil their future and become a burden to society. Therefore, it is the duty of a teacher to train every student to develop some hobbies related to science. A good scientific hobby helps in giving an outlet for a child's inquisitiveness and creative facilities. It cultivates in the child a love for work and desire to produce something useful and serviceable. In short, education must be made recreational and profitable if possible.

A hobby is not a regular activity in the curriculum of schools. Therefore, science club should provide opportunity to develop the hobbies in children. Science Teachers have to identify the students' interests and pursue the development of their hobbies. There are so many hobbies like chart making, drawing, painting, photography, reading/writing of science fiction, collection work, assembling of electrical

gadget like radio, iron box, calling bell, bird watching, night by observation etc.

Chart-making

In science clubs children may be asked to prepare charts on scientific principles, experiments, puzzles, news, statements, quotations, inventions, discoveries, auto biographies, life cycles, etc. The charts can also be prepared by pasting photographs, pictures, news items, herbarium collections etc. Preparation of charts keeps the students active and develops study habits. The practice of consulting reference books, healthy competition and editing are also developed.

Drawing and painting

The student, having the ability to picturise their observations may be encouraged for this activity. They not only develop their drawing skills but also improve the speed and accuracy. Therefore, science teachers should encourage the interested children for drawing, painting and poster making on concepts, principles and themes of science.

Photography

Some students may be interested in photography. Science club should provide proper training and necessary material, (like hypo, dark room facility, camera, etc.).

Science games

Science club members should be provided with the materials to prepare science games such as card game (related to vitamin, digestive system), snake and ladder (related to pollution, healthy living), memory game, games related to name of scientists etc.

Collections

Collections related to science is a very good hobby and is to be developed among students. The students may be encouraged to collect some of the following materials.

- | | |
|------------------------------------|---|
| 1. Dyes | 8. Birds/insects |
| 2. Seed | 9. Dyes |
| 3. Specimens | 10. Lenses/coloured glasses |
| 4. Different types of stones/rocks | 11. Crystals |
| 5. Different types of soils | 12. Pictures/Photographs of scientists |
| 6. Fertilizers | 13. Collection of articles related to science |
| 7. Flowers/leaves | |

Preparation of pamphlets

Pamphlet preparation is another important activities of science clubs related to the development of hobbies. Pamphlet should be carefully prepared considering the need, importance, strength and financial resources. Pamphlets bring general awareness of a scientific concept. They also help in popularization of science among students and public. The following topics may be suggested for the preparation of pamphlets.

1. Oral Hygiene
2. Hair Care
3. Care of Teeth
4. First aid for snake bite
5. Protect yourself from insects
6. Personal hygiene
7. Protection of eye from diseases
8. The monthly cycle - problems and solutions
9. Save yourself from electric shocks
10. Do it yourself!
11. Care for the skin
12. Precautions in chemistry lab.
13. Food adulteration - detect yourself
14. Balanced diet

Preparation of socially useful materials

Objective:

1. To apply the knowledge of science in daily situation.
2. To inculcate among the students the habit of hard work and desirable traits of character.
3. To develop useful occupational skills
4. To provide students with educational and vocational guidance.
5. To train the pupils to utilise their leisure most effectively by catering to their individual interests through a number of activities.

The committee which has been assigned the work of preparation of materials should look after this activity. The club can also make the funds by selling these useful materials to the students or people.

The list of some suggested preparation is given.

1. Preparation of soaps
2. Preparation of vanishing cream

3. Chalk pieces
4. Boot polish
5. Tincture iodine
6. Nail polish
7. Blue indelible ink
8. Nail polish remover
9. Rodent killers
10. Insect sticks
11. Layering
12. Mushroom culture
13. Grafting plants
14. Greeting cards
15. Shell toys or garlands/flower bouquet
16. Preparation of juice
17. Preparation of jams
18. Preparation of pit-manure

Procedure for preparation of some useful materials

1. Vanishing Cream

Materials required

- | | | |
|------------------------|---|-----------|
| 1. Stearic acid | - | 4 parts |
| 2. Potassium Carbonate | - | 1/2 parts |
| 3. Borax | - | 2 parts |
| 4. Glycerine | - | 1 part |
| 5. Water | - | 24 parts |
| 6. Any scent | - | few drops |

Take the stearic acid in a beaker and melt it over the flame. To this add a solution of potassium carbonate and borax and stir continuously. Now add glycerine and mix well. Let it cool and add a scent and preserve in a bottle.

2. Washing soaps

Materials required

- | | | |
|-----------------|---|-------------|
| 1. Maida oil | - | 1 part |
| 2. Sesame oil | - | 1 1/4 part |
| 3. Maida | - | 1 part |
| 4. Caustic soda | - | 1 part |
| 5. Water | - | 5 1/2 parts |

Mix maida in oils in an iron vessel. Dissolve caustic soda (NaOH) in water and go on adding it into the mixture of maida and oil. Stir well and put into moulds.

3. Chalk pieces

Materials required

- | | | | |
|----|------------------|---|-----------------|
| 1. | China clay | - | 1 part |
| 2. | Plaster of Paris | - | 3 parts |
| 3. | Water | - | to make a paste |

Mix china clay with plaster of Paris and water. Make a paste and put into the mould. Remove from the mould after 6 or 7 minutes. Add colour into the paste for coloured chalks.

4. Boot Polish

Materials required

- | | | | |
|----|----------------|---|----------|
| 1. | Paraffin wax | - | 5 parts |
| 2. | Carnauba wax | - | 5 parts |
| 3. | Bee wax | - | 5 parts |
| 4. | Turpentine oil | - | 50 parts |
| 5. | Bismark | - | 3 parts |

Melt all the waxes and then add turpentine oil and colour. Mix well and preserve in tins.

5. Tincture Iodine

Materials required

- | | | | |
|----|------------------|---|---------|
| 1. | Iodine | - | 1 part |
| 2. | Potassium iodide | - | 1 part |
| 3. | Spirit | - | 5 parts |
| 4. | Water | - | 2 parts |

Dissolve the potassium iodide in water and iodine in alcohol/spirit. Mix both the mixtures.

6. Nail polish

Materials required

- | | | | |
|----|---------------------|---|---------------------|
| 1. | Talcum | - | 5 drachms |
| 2. | Stannous oxide | - | 3 drachms |
| 3. | Powdered Tragacanth | - | 5 grain |
| 4. | Glycerine | - | 1 drachm |
| 5. | Rose water | - | Sufficient quantity |
| 6. | Carmine | - | |

Take talcum powder, stannous oxide, powdered Tragacanth, glycerine, rose water and carmine. Mix all these ingredients and make a paste.

7. Blue indelible ink

Materials required

1. Lac - 4 parts
2. Borax - 2 parts
3. Gum arabic - 2 parts
4. Neel - 2 parts
5. Water - 40 parts

Add lac in the boiling solution of borax in 36 part of water. Filter the mixture. Dissolve gum arabic in 4 parts of water and add it to filtrate. Cool the mixture. Add neel and keep it aside for sometime. Decant it and collect in the bottle.

Ink of various colour may be made from a strong decoction of the ingredients used in dyeing mixed with little alum and gum arabic.

8. Nail Polish Remover

Materials required

1. Alcohol - 1 part
2. Ether - 1 part
3. Acetone - 1 part

The above chemicals can be mixed in the mentioned proportions.

Layering

1. Air layering
2. Soil layering

Air layering

Materials required

Suitable plants, knife, polythene paper, suitable soil.

Suggested plants : Rose, Croton, Hibiscus, Guava

Remove a small piece of bark from any branch of the selected plant. Cover it immediately with wet soil. To protect, cover it with polythene paper and tie it. Remove it from the parent plant after and transfer it to a suitable place.

Soil layering

Materials required

Suitable plants, knife.

Suggested plants : Rose, croton.

Remove a small piece of bark from lower branches of the selected plant. Bend it and cover with soil firmly. Separate it after rooting and transfer it to a suitable place.

Mushroom culture

Materials required

Spawn, baskets, hay, water

Arrange hay in layers in a suitable basket. Soak with water. Spray mushroom spawn on it. Place it in a dark room and sprinkle water now and then and maintain low temperature.

Guidance from experts could be taken for proper culture.

Orange juice

Materials required

Knife, black pepper, salt, glass, ice, orange or mombi, strainer, water.

Collect the following ingredients for one glass juice. Orange 3-4, salt 1/4 teaspoon, black pepper 1/8th teaspoon. Wash the fruit thoroughly. Cut the fruit into half, remove the seeds and squeeze out the juice from the fruit. Pass it through a strainer. Add salt, pepper and ice. Serve chilled. This can be preserved by adding potassium metabisulphite.

Dramatics

Dramatisation provides enjoyable and meaningful learning experiences. They are equally effective for the lower to the higher level of students.

Objectives

1. To help the pupils in getting over their shyness.
2. To develop cooperation among the pupils.
3. To develop imagination, aesthetic appreciation.
4. To make pupils appreciate the division of labour.

5. To provide opportunities for individuals to analyse the various players positions, beliefs and values.

6. To provide opportunities like making decisions, developing action oriented human relation skills.

Different types of dramatic.

1. Role play : In this, the child takes an event/situation and acts.

2. The play : The planned and rehearsed acting of a story is a play. A play provides a substitute for a real situation.

3. Pageant : The pageant is more spectacular than the play. It pays more importance to setting and action and less to speech.

4. The pantomime : In a pantomime the performers express themselves through body actions, in accordance with music. Announcement of any clue about the event will not be given to the audience.

5. Puppet Plays : Puppetry is popular and old art in Indian villages. Stories/events are selected and puppet plays are conducted by the various movements of the puppets.

6. Shadow plays : The story chosen for a shadow play should be one with plenty of action. A shadow-play may be with or without speech but music is essential.

Value.

The dramatic activities develop the child physically, intellectually and socially. It is the child's natural way of learning and growth. It is on par with the one of the core elements of NPE 1986, "Cultural Heritage".

Some examples

1. Playlets may be written on the life histories of scientists, on the blind-beliefs of the people.
2. Assigning different characters to different pupils like the food items, their properties can be played.
3. Each student can be given name of one element by the teacher. The students give some clues through actions about salient features of these elements. Later through their interaction they show the play about the formation of different compounds/chemical reactions.

Magic and fun games

These are the games of fun in which scientific principles are involved.

Objectives

1. To make the pupils understand the scientific principles involved in each act.
2. To make the pupils derive the joy from science related activities.
3. To develop creativity, curiosity, interests, sense of appreciation among the pupils.
4. To develop skills in observations, experimentation, construction, imitation and imagination among the pupils.
5. To utilise the leisure in useful way.
6. To eradicate blind beliefs, unscientific traditions and customs.

Organisation

The science club members develop some game and demonstration/show. They may also invite the magicians to perform magic show/fun games based on scientific principles. They should keep a record of the magic shows with their procedures. Based on these, they can also develop new games.

They may arrange these shows once in a month or at the beginning of important functions of the school/science club.

Example of fun games

1. Water boils without fire

Materials required

One round bottomed flask with a tight fitting cork, water and arrangement to heat it.

Procedure

Fill the flask with water and put on fire to heat. When water begins to boil and flask is full of steam produced by the boiling water, tighten the cork on its mouth. Remove it from the fire and hang the flask upside down and make sure that the water is not boiling now. Once the water surface is quiet just squeeze some cold water on its tip with the help

of a cloth piece. With little sprinkling of cold water, water inside the flask starts boiling again.

2. Peel banana automatically

Materials required

One fully ripe banana, a bottle whose mouth should be almost equal to banana flesh in diameter. Little spirit and a piece of cloth and match stick.

Procedure

Soak the cloth piece with spirit, drop into the bottle. After this put a lighted match stick. Now peel the banana a little from the top and put the flesh on bottle's mouth in such a manner that its opening is completely blocked without allowing any air to pass. The part of banana peel that is covered with spirit will burn outside. Soon it will be noticed that the mouth of the bottle gradually starts sliding into the bottle leaving the peel outside.

Some suggested fun game are

1. Floating of egg on water (density of water increases with the addition of common salt).
2. Carrying water in a line with holes (air pressure)
3. Paper snake (change of density of air on heating)
4. Love of ice pieces
5. Boiling water in a paper pot
6. Secret message
7. Why does Sila love Rama? (Magnetic properties)
8. Obedient tin
9. Automatic fountain
10. Swinging candle
11. Ice with boiling water
12. Power house in lemon
13. Non flammable thread

Few more activities can be added based on our daily life experiences.

Service to the community

A lot of service, in different forms and touching different aspects of life, which shapes the student's personality and build up their character, could be taken up by the members of the club. It should be felt by them to have such an interaction with the society in which they are going to be members in near future, would mould themselves as exemplary citizens. In doing so, they identify themselves with the society and would be advantaged with the information and experience they gain.

Example :

A science club member can bring in social awareness by conducting simple experiments.

1. He can conduct simple experiments to find out the percentages of fluoride and also the hardness of water and such others and report the facts to the authorities for fluoridification to save the society from health hazard.
2. He can educate the public by arranging the street corner meetings on common causes of ill health that crop up due to some insanitary conditions prevailing in the surroundings, the causes of the spread of epidemics and the methods of prevention.
3. He can bring into light the dangers of bad food habits and their resultant effects.
4. He can work out to bring in social awareness about the dangers of deforestation and advantages of the afforestation.
5. He can explain the dangers of excessive usage of fertilizers to farmers.
6. He can explain the methods of servicing of the implements of agriculture for their longevity.
7. He can make farmers understand better about the use of pesticides, fungicides, and insecticides and safeguarding the harvest from birds and rats.
8. He can educate the public regarding hazardous effects of different kinds of pollution such as water, air, land and sound, and to educate them not to cause any such pollutions and spoil the balance of the nature.
9. He can bring awareness among the public to protect the wild life and species that are facing extinction.

10. The students may felicitate such people (involved in social service) of honour, dignity and importance.

Many more such activities could be planned and organized depending upon the local conditions and environment. Hazards that crop up by smoking and alcoholism and population explosion be explained.

Field Trips

Objective:

1. To get first hand experience
2. To review the knowledge already learnt.
3. To make optimum use of locally available resources.
4. To collect material and information from the places visited
5. To appreciate the role of science in society.
6. For vocational guidance/To expose them to world of work.

Planning

Selection of place of scientific importance

The place to be visited should be carefully selected. It should have educational/scientific value.

Size of the group

Number of participants for the field trips should also be decided in advance. The group should not be too large or too small. Fifteen to twenty students accompanied by two or three teachers is considered to be ideal.

Date, time and duration

The dates, timings and duration of field trips should also be planned in advance considering the strength of the group, mean of transport, objectives, need, etc.

Advance preparation

1. It is always better if the teacher-in-charge visits the place in advance.
2. A meeting should be organized before the field trip. The students should know the objectives of the trip, place to be visited, scientific importance of the place.

preliminary measures, material to be carried in advance, necessary permissions to visit the place may be obtained in advance.

Committees and sub-committees

Students should be organized into several groups. Each group should be assigned with a specific work such as carrying of materials, collection, discipline, etc.

Informing parents in advance

Parents should be kept informed regarding the purpose of the field trips, places to be visited, etc. in case of long field trips. It is always advisable to take consent from parents in advance.

Transportation

Most of the field trips to nearby places do not require transportation. Transportation should be arranged in advance for long field trips. The teacher-in-charge could be given the choice of means of transportation.

Finance

Students should be kept informed about the financial implications of the trips. Amount to be collected from students, proposed expenditure should also be planned well in advance.

Equipment

Students should be kept informed regarding the material to be carried to field trips in advance such as required dress (food, water, first aid box, gadgets to be used for collection of materials, preservation of materials, books, etc.)

Organization

Time

Dates and timings should be informed to students. The teacher in charge should see that timings are maintained as per the schedule. A little deviation is permissible.

Fulfillment of objectives

Teacher in-charge should see that the set objectives are fulfilled. He/she should guide students throughout the field trip for the fulfillment of objectives.

Alternate resources/plan.

The teacher in charge should be resourceful. He/she should make immediate alternate arrangements in case of difficulty. The plan should not be rigid. It could be modified and when required.

Role of teacher in charge

The teacher in charge should guide and inspire students throughout the field trip. He/She should motivate students to learn the concepts by asking questions. Necessary suggestions should be given wherever needed. He/She should also look after safety, security and material transport.

Execution

As far as possible the field trip should be executed as per the schedule. Collections, observation, note making etc. have to be carried out as planned. Students should know about the nature of specimens to be collected technique to be adopted in advance in case of collection trip. Survey/Case studies/interviews/observation can also be taken up during field trips.

Follow up activities

This is another important aspect of field trips which is often neglected.

Post field trip discussions

A post field trip discussion may be arranged to exchange views on field experiences, concepts learnt, problems faced, suggestions for better organization etc. The students who have not gone for the field trip may also be called and encouraged to interact in the meeting.

Sum ups/Reports

The participants may be asked to write reports on the field trip with their personal experiences. The reports should be innovative and creative and not necessarily be descriptive.

Writing for newsletters/magazine

Articles can also be written for school magazines/newsletters with photographs/pictures of places visited during field trip.

Project

Field trips could be used for carrying out some projects such as collection of specimens, data, observations, etc. Projects may be well defined and assigned in advance.

Competitions

Various competitions such as essay writing, drawings, paintings, etc. can be conducted on field trip experiences.

Assignments/Assembly programmes

Some assignments may be given to members and the best may be awarded prizes. Members can also give speeches in school assembly explaining their experiences.

Types of field trips

There are many kinds of field trips such as

'Let's go and see' field trips

Much preparation is not required.

Short field trips

Field trips to nearby places which do not require transportation. Duration of these may be from few hours to a day.

Long field trip.

Field trips to far off places for which duration may be for few days. They require elaborate preparations, including transportation, materials, finance, permissions, etc.

Other field trips

Optional field trips which are not compulsory, voluntary field trips which are planned by the students with enthusiasm, nocturnal trips, trekking, hiking, bird watching, night sky observation (where telescope is available) etc. are examples of other types of field trips.

A list of places of scientific importance is given. However, the club can select a place which may not be included in the list.

1. Local Clinics
2. Health Centres/Medical Colleges
3. Research Laboratories/Industries
4. Pathology Laboratories

6. Breweries
7. Rubber mills
8. Saw mills
9. Food manufacturing units
10. Soft drink manufacturing units
11. Sewage disposal plant
12. Water treatment plant
13. Agricultural fields
14. Nurseries
15. Local gardens
16. Air conditioning unit.
17. Ice cream manufacturing units
18. Milk cooling units
19. Gas factory
20. Zoological parks
21. Botanical gardens
22. Poultry farms
23. Planetarium
24. Museum
25. Hill stations
26. Horticultural stations
27. Sanctuaries
28. National parks
29. Observatories
30. Exhibitions
31. Forest
32. Beach
33. Riverside
34. Ponds lakes
35. Wood shop
36. Metal shop
37. Local market
38. Neighbouring homes
39. Community service centres
40. Fire stations
41. Sterilisation units
42. Excavations
43. Bridges
44. Local schools
45. Other school laboratories
46. Quarry

Projects

Projects form an integral part of science club activities as well as science teaching.

Objectives of science projects

The objectives of science projects are many. A few of them are listed below.

The project work

1. develop the ability to analyse and interpret data
2. develop process skill
3. make scientific concepts and principles more meaningful.
4. encourage independent thinking
5. develop analytical, critical and creative thinking and intellectual understanding
6. develop the ability of interaction and adjustment in social groups.
7. develop the skill of solving problems
8. develops confidence, co-operation, leadership quality in the student.
9. promote curiosity and develops scientific temper.

Project is a whole hearted purposeful activity carried out by the students in or outside the school. It is a self-learning method involving investigation, discovery or finding out something which will not be known to the students before. One of the most comprehensive definition is "A project is a significant, practical unit of activity having educational value and aimed at one or more definite goals of understanding, involves investigation and solution of problem and frequently the use and manipulation of physical material, planned and carried to completion by pupils and teachers in a natural 'real life' manner. (Good, 1973). The projects can be as varied as pupils are. Projects vary from simple to complex. They may be performed individually or in groups. It need not always be a new or original. Even if the student copies, he may arrive at new idea and new methods of learning.

Procedures to be adopted while carrying out the project work

Projects are normally initiated by the teacher. However, a talented student can select his own project and carry out individually. Knowing the talents and capabilities of the student, the teacher may guide him properly.

Planning

1. The teacher incharge shall plan the following areas.
 - a. Selection of the students for the project work.

which may include manipulation, organisation, experimentation, interpretation, etc. To familiarise with certain concepts, principles and methods, the students may refer book or advanced level of knowledge or take help of the experts in the field. In some of the investigatory projects, the student may not be able to draw conclusions by him self but he can do so with the help of teacher or in some cases he may not arrive at any result.

Examples of a few science projects with procedure

1. Factors affecting the time period of simple pendulum.

Materials required

- i) Pendulum bobs of different sizes
- ii) Different lengths of thread
- iii) Pendulum of different material.
- iv) Stop clock

Factors to be studied are : amplitude, length of the pendulum, mass of the bob of pendulum and size of the bob of the pendulum. The time period is noted by varying each of the factor above in turn. Finally the conclusions are drawn from the experimental observations and a project report is prepared.

2. Comparison of growth rate of dicot and monocot plants.

Material required

- i) Healthy seeds of atleast ten dicot plants
- ii) Ten monocot plants
- iii) Soil
- iv) Water
- v) Scale etc.

Procedure

- i. Prepare twenty plot of equal surface area in a garden (germination boxes or petridishes also can be used).
- ii. Sow ten seeds of each plant in separate plots.
- iii. Water them regularly.
- iv. Ensure that depth, light, distance between two seeds are uniform in all plots.
- v. Measure the length of all plant after five days after germination and take the average values.
- vi. Compare the growth rate and draw inferences.

vii. Tabulate the observations.

viii. Draw histograms.

ix. Preserve all the plants.

3. Study of naturally occurring colouring matters and possible acid base indicators.

Materials required

- i. Test tubes of identical dimensions
- ii. Inl fillers
- iii. Burette 50 ml
- iv. Pipettes 10 ml and 5 ml
- v. Conical flask
- vi. Test tube stands
- vii. Round bottomed flask and condenser bottles to hold indicator solution

0.1M HCl, 0.1 and 0.4M NaOH, 0.02M solutions of acetic acid and sodium acetate, methyl orange, methyl red, phenolphthalein, red rose petals, hibiscus flowers, turmeric powder and ethanol.

Procedure

i. 10 gm of turmeric is extracted with 250 ml alcohol by heating it under reflux with alcohol. The extract is concentrated to about 100 ml and stored in a bottle. Hibiscus and rose petals are dried in shade and powdered. The powders are ground with hot water till the respective dyes are extracted. The extracts are filtered and stored in bottles.

ii. Each of the indicator solutions is used in titrations of 0.1M NaOH with 0.1 M HCl. The variation tried are in the number of drops of indicator, the dilution of the indicator solution.

The following solutions are prepared.

iii. Solution X - 5 ml of indicator and 1 drop of conc. HCl.

Solution Y - 5 ml of indicator and 1 drop of 4 M NaOH.

iv. 18 Test tubes in nine pairs are arranged one behind the other in a double test tube rack so that when looking through any pair of test tubes, the colours seen would be due to the solutions in both test tubes.

v. 5 ml of distilled water in each of the 18 test tubes and drops of X and Y are added to each of the tubes as shown below:

Tube	1	2	3	4	5	6	7	8	9
drops of A	26	27	28	29	30	31	32	33	34
drops of B	10	11	12	13	14	15	16	17	18
drops of C	9	8	7	6	5	4	3	2	1

ix. Equal volumes of 0.02N sodium acetate and 0.002N methyl red are mixed. A 5 ml. of this mixture is taken in a test tube. 10 drops of the standard solution, the C in the rack, five drops of the indicator are added to this mixture. This test tube is placed in front of each of the pair of test tubes in the rack and the colour compared with the colours seen by looking through the pairs of the test tubes in the rack. The best match is noted (If possible, the test tubes in the rack could be illuminated from behind, using a tube light).

x. Steps 2 to 6 are repeated with each of the three indicators and the test tube pair in which the colour matched the best with the colour in the buffer solution noted in each case.

Result

The observed colour changes during titrations of the 0.1M NaOH solution with 0.1M HCl were as follows.

Phenolphthalein - Yellow to orange red (sharp)
 Methyl red - Green to red (sharp)
 Bromocresol green - Red to green (not very sharp)

List of suggested projects for senior classes (secondary)

Biology

1. Observation of bacterial colonies on cooked potatoes.
2. Effect of temperature on enzyme activity.
3. Effect of water on seed germination.
4. Comparison of heart beat of different animals.

Chemistry

1. Study of the time of flow of liquids through a burette. Comparison of flow times with composition of liquid pairs.

2. Estimation of the reducing sugar content of sugarcane juice
3. Comparison of the nicotine content in some commercial brands of cigarettes.
4. Estimation of the ascorbic acid content of fruit juice
5. Isolation of amino acids from natural sources and their identification by chromatography.
6. Analysis of different metals in alloys.

Physics

1. Study of effects of temperature on viscosity.
2. Determining the magnetic field on the axis of an improved coils at different distances from the centre of the coil.
3. Studying the effect of addition of different concentration of salts on boiling point of a substance.
4. Studying the effect of temperature on power of a dry cell.

List of suggested projects for junior classes

1. Collection of different insects, fishes, etc. and classifying them.
2. Collection of different types of leaves and studying their differences.
3. Studying the tensile strengths of different types of fibres
4. Study of physical properties of different metals.
5. Comparison of growth rate of dicot and monocot plants.
6. Collection of different types of solids (amorphous and crystalline) and studying their properties.
7. Diffusion of gases.

Working and Static models

Objectives

1. The students are given opportunity of understanding scientific principles better.

2. Develop the psychomotor ability of the students.

Procedure:

This activity can be carried out in groups or individually. These models may be prepared in the laboratory or outside. Opportunities should be given to the student to prepare models in different branches of science. With the imagination of the teacher and students, many types of models can be constructed. The students should be encouraged to prepare low cost models.

Given below are few working models.

1. Hydraulic lift

Principle involved : Pascal's law

Material required

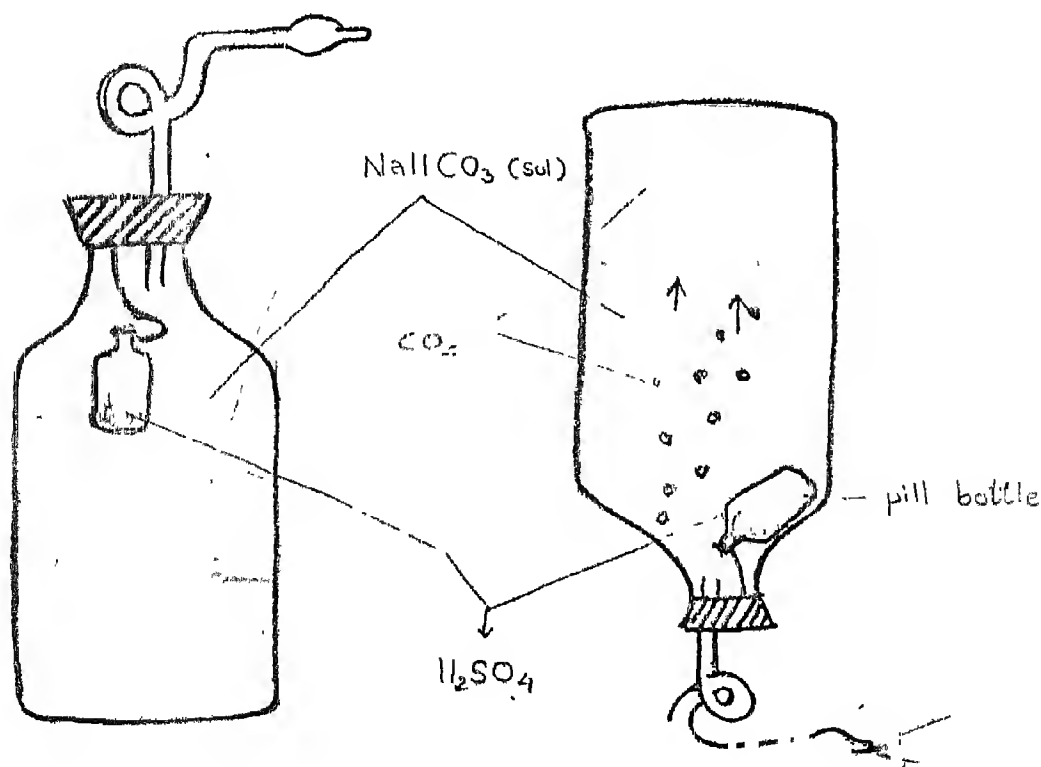
- i. A small tin box
- ii. A tight fitting cork
- iii. Rubber tubing and glass tubes
- iv. Wax

Procedure:

A hole is drilled at the side of the tin to which a cork with glass tube is fixed air tight. Some water is taken in the tin with a layer of wax which acts like a platform to keep object which are to be lifted. The rubber tube is connected to the glass tube. When air is blown through the tube, the platform starts rising.

2. Home made fire extinguisher (chemical fire extinguisher)

Figure:



Materials required

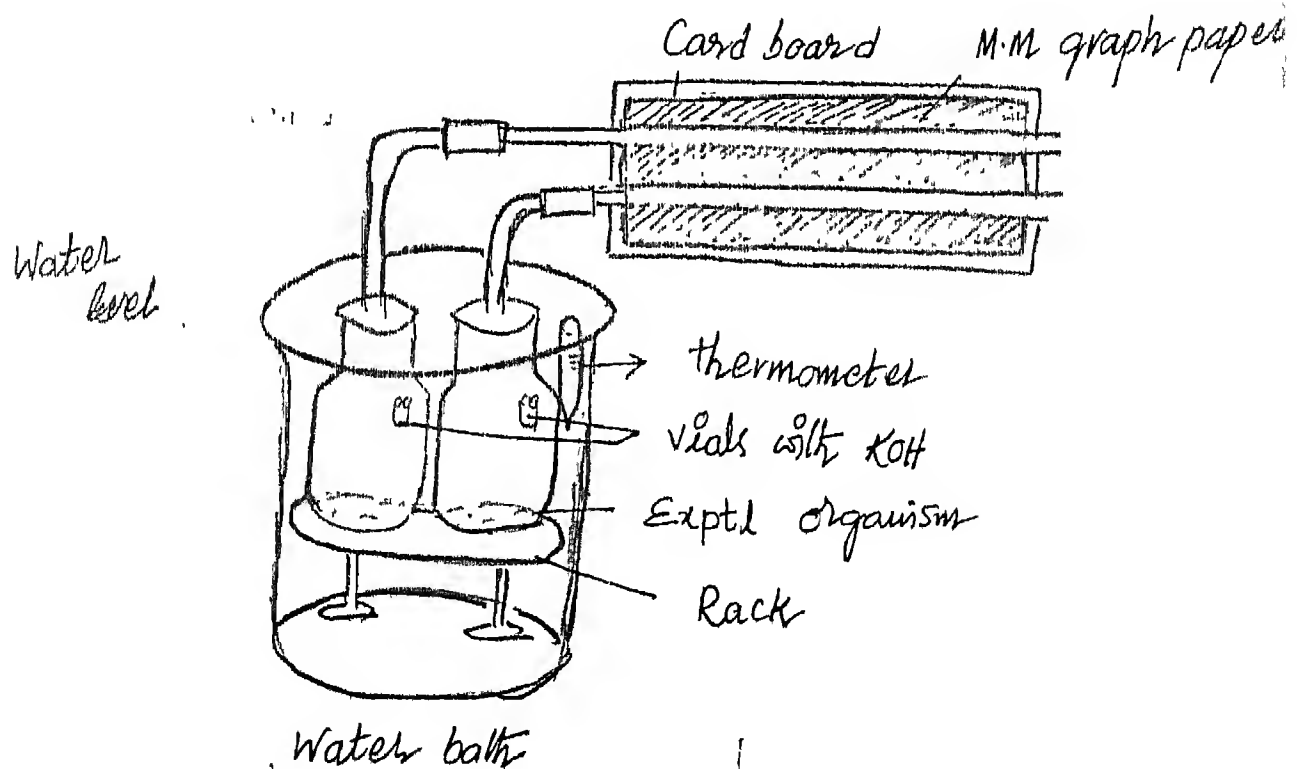
- i. Ink bottle
- ii. One-holed cork
- iii. Glass tube with jet
- iv. Pill bottle
- v. Solutions of sodium bicarbonate
- vi. Dilute sulphuric acid.

Procedure

Half fill an ink bottle with sodium bicarbonate solution. Fit it with a one-holed cork through which a glass tube of about 7mm. outside diameter bent at right angles is passed. The end outside the bottle should be a jet. Take a few ml of sulphuric acid or acetic acid in a pill bottle and tie a thread to it. Close the acid bottle with a cork from which a sector has been cut to make the acid come out slowly. Suspend the thread through the cork and close it tightly.

To operate the fire extinguisher, invert it.

1. Respirometer



Materials required for construction

- i. Any large tin or glass container
- ii. Two wide mouth bottles
- iii. Two one-holed rubber stopper
- iv. 12" of 5 mm glass-tubing
- v. Two 3" pieces of capillary tubing

- vi. Rubber tubing
- vii. 24 gauge iron wire
- viii. Rubber bands
- ix. Medicine dropper
- x. Graph paper
- xi. 6" x 36" cardboard piece
- xii. Filter paper
- xiii. Two small test tubes or injection bottles
- xiv. One thermometer
- xv. One small wooden stand
- xvi. One cork

Procedure for construction

- i. Cut the 5mm glass tubing into two 6" pieces and bend each 2" from one end to form a 90° angle.
- ii. Connect the 2" end of each glass tube to the capillary tubes by using a small piece of rubber tubing.
- iii. Fill the long ends of the 5mm tubing to each of the one holed stoppers.
- iv. Take 2 pieces of filter paper and dip them into the KOH solution. Put them into the small test tubes or the injection bottles.
- v. From the iron wire make a loop which fits the necks of the test tubes. Bend the rest of the wire upwards and into a hook which you will attach to the tip of the wide mouth bottles. Wrap a rubber band around the bottle to secure the wire to the side of the test tube. The test tubes should now be suspended inside the wide mouth bottles.
- vi. Close the wide mouth bottles with the rubber stoppers mentioned in step 3 above.
- vii. Attach the graph paper to the cardboard piece and then fix this piece behind the capillary tubes.
- viii. Place the stand in the large container and put the two wide mouth bottles in it. Secure in place with rubber bands.
- ix. Pour water into the large container until it comes to the necks of the bottles.
- x. Fix a thermometer in a cork and float it in the water.

- xi. Put a small cockroach or any other insect, whose respiration you wish to measure, in one of the wide mouth bottles.
- xii. Introduce a drop of coloured water into the capillary tubes and the apparatus is ready for your experiment.

Static models

These can be prepared using thermocole, wax, cardboards, plywood, etc. These are useful in studying details of device machine or instrument.

1. Model of a computer
2. Model of a nuclear reactor
3. Model of a microscope
4. Model of a furnace, etc.

Improvised learning aids

With the help of students learning aids (low cost) can be prepared which are helpful to classroom learning. Some of the suggested models are

1. Water level indicator
2. Burglar's alarm
3. Cable cars
4. Co-efficient of linear expansion model
5. Automatic pumping system
6. Hydro-electric power (working model)
7. Studying the molarity of a solution using photodiodes
8. Excretory system model
9. Model of flower (LS)
10. Working model of heart
11. Working model of brain
12. Model on Industrial pollution
13. DNA and RNA model
14. Model of distillation, thermostat
15. Metal extraction process
16. Electrolysis set

Charts

Objectives

1. Charts help in understanding the diagrams clearly.
2. The imagination of the students can be exhibited by the charts.

This activity is preferably carried out by individuals. While preparing charts the following points are to be kept in mind.

1. Charts should be large.
2. All lines should be distinct.
3. Printing should be readable from every part of the room.
4. Colour should be effective.
5. The diagram should be properly labelled.
6. Diagrams should be scientific.
7. Permanent charts should be prepared on special chart cloth which has longer life.

Survey

This is an interesting activity. The students will have an opportunity to go to nearby localities and interact with the people. The students will be asked to choose any topic of their interest. They go to people and collect the data and prepare a report and interpret the result. This activity should be carried out outside the school hours. This will give an opportunity to the students to utilize their leisure properly. One example is given below:

Food habits of the people of particular area/different castes

The data on the following aspects is collected by the students.

After collecting the data, they analyse taking into consideration age, sex, occupation, socio-economic background, etc. and interpret data. This develops the analyzing ability of the students. Surveys can be conducted by using questionnaires.

Interviews

The students can be encouraged to interview professional experts of nearby places like a scientist, a farmer, a doctor, etc. By interviewing the students can develop their communication skills and at the same time they can enrich their scientific knowledge as well and thus they can choose their field of interest. For example, when a student interviews a doctor, he can find the causes of different diseases, their prevention and cure. This enriches his knowledge and at the same time, he may get influenced by the person and at the same time, he may get influenced by the person and may decide to become a doctor and get motivated in medical line. He can find from him the modes and means of reaching his goal.

Case study

Objectives

1. For indepth study of specific subject.
2. To carry out innovative experimentation.

The topic for case study can be chosen either by the student himself or by the teacher. For example, the students can study why the water is contaminated in the nearby localities. He can go to different sources of water of a locality and find the quality of water. He can go and find out the sanitart conditions of the locality, the existence of industries, factories, etc. After collecting the data he can draw the conclusions why the water is contaminated. The society can be benefited by this type of case studies. The student can also educate the people properly to have proper sanitary habits to minimise the water contamination.

Science museums

Science museum forms an essential part of a science club. The purpose of science museum is to provide an opportunity to the students to preserve and display rare objects of scientific importance which are collected by them. The museum also helps to educate the students as well as the public.

Planning and organisation

Proper planning is required for the following aspects.

1. Finance
2. Collection and preservation of museum articles
3. Display
4. Maintenance
5. Selecting volunteers to carry out different activities of the science museum.

Finance

A committee should be formed to plan a programme to raise the funds to develop the museum. Donations can be collected from local people, from staff members and students. A part of the fund that is allotted to science club may be utilized to develop the museum.

Collection

Next step is the collection of articles for museum. A science fair may be the beginning. There may be some exhibits in the science fair which can be preserved for future instructional purposes. Perhaps some of the charts which can be used again and again can be preserved in the museum. A little time spent in canvassing may result in revelation of some of the important educational materials in the nearby localities that can be brought to the schools or can be acquired on a loan basis and displayed for a month or so. Pupils' projects of superior quality can be added to the museum. The museum should include materials from different fields of science. Things like rocks, dyes, drugs, ores, shells, specimens of animals and plants, feathers, skeletons

of animals can be preserved and displayed in museum. More details are given in the topic 'Collections and Preservation'.

Display

To begin with the museum could consist of a shelf with glass doors with a few objects which is placed at a place where they can be seen by all the students. If the materials outgrow the space, they can be stored in boxes till sufficient space is available. When the number of materials increases, a separate room can be allotted where permanent arrangement for displaying can be made. Each object should be properly labelled and displayed in an orderly manner.

All the articles of the museum should be classified subject-wise and be placed at different places of the room. Different types of rocks, minerals and ores can be kept at one corner. Various types of birds at another corner. Aquatic animals can be put at some other place. With little imagination of the members of the science club, the museum can be made attractive and interesting. Even a mobile museum can be developed which can be taken to nearby localities and schools.

Maintenance

Preservation is most important task of maintenance. Small minerals and fossils can be preserved by embedding them in plaster of Paris. Pupils who are skillful can be encouraged to make small wooden blocks with sloping face where the samples can be fixed. The identification card for the preserved material/specimens must be fixed on the sloping surface. All the biological specimens must be properly preserved in glass jars and the level of formalin in the jar should be frequently checked. All the electrical equipments should be checked occasionally.

Cataloguing

All the materials added to the museum should be properly catalogued preferably subject wise. Writing in a note book or on cards is preferable. To carry out all the programmes of museum successfully committee should be formed from enthusiastic students and teachers to look after each aspect of the museum.

Publicity

Proper publicity about the museum should be given to students and local people through pamphlets or any other convenient means.

Tackling day-to-day problems relevant to daily life in society

A number of activities can be arranged exclusively for the public to generate scientific awareness and to remove superstitious beliefs among the public especially in rural areas. These special activities with a definite goal should be conducted as frequently as possible, preferably on holidays other than festival days. After the end of every activity which is demonstrated by a participant, the scientific principle involved in and its uses can be explained to the public preferably in their regional languages. The demonstration and explanation of various activities say twenty in number should last at least for three days, so that all the public can make use of it. Even the activities may be in the form of talk/lecture by an expert or an exhibition. At least once in a month such talk or exhibitions/demonstrations should be arranged. The exhibition committee in consultation with the executive body can plan, prepare and organise these special activities. The date, time and venue (preferably in the school campus) should be announced at least one month in advance. Publicity also can be made so that maximum number of people can make use of these activities. A sample set of activities of various types are mentioned below.

Talks/Interviews/Dramas/Film shows/Demonstrations

1. On Health and hygiene,

- i. Nutritious food
- ii. Necessity and uses of a clean and tidy environment.
- iii. Prevention of contagious diseases i.e. Aids, Cholera, Measles, Chicken pox, etc.
- iv. Importance of vaccines in preventing the diseases.

2. Energy

- i. How to save energy
- ii. Use of non-conventional sources of energy

3. Agriculture

- i. Uses of pesticides and insecticides
- ii. Uses of fertilizers
- iii. Agricultural methods like crop rotation, irrigation, methods, vegetative propagation for certain fruits like citrus, mangoes, etc.
- iv. To improve quality of poultry and cattle
- v. Sericulture, Horticulture, prawn culture, fish culture, etc.

4. Pollution

- i. Types of pollutants
- ii. Causes of pollution
- iii. Effects of pollution
- iv. Minimization of pollution

5. Electricity

- i. Proper use of electricity and minimisation of consumption
- ii. Safety measures

6. First aid

- i. Use of plants
- ii. Use of drugs

Aquarium/Vivarium/Terrarium

The habits and mode of life of different animals can be observed and discussed including their movements, breathing, feeding and reproducing through aquarium and vivarium. Aquarium is the best means to study eco-system in classroom.

Aquarium

Mini aquarium

1. Use large jars and put a 2 cm layer of gravel, some water plants; fill up with pond or well water and add one or two species of pond animal.
2. Keep the jars on a window edge, but not in bright sunlight.
3. Small aquaria of this kind are far better than larger ones for the observation of particular plants, small insects and larvae.

Larger aquarium

1. A tank of approximately 60 cm long, 30 cm wide and 30 cm deep is suitable. The cover may be of glass.
2. Water from well or river is usually preferred. Two litres of water is needed for every centimetre of fish.

3. For small fish and other small water creatures, growing weeds will supply sufficient oxygen.
4. The plants may be fixed at the bottom down in the gravel by stones or by pieces of lead or zinc. They soon root themselves and produce new stems.
5. Pebbles and gravel must be thoroughly washed with $KMnO_4$ / 4 before use. Sand should be avoided as it holds decaying matter. One or two larger stones may be placed on top of the gravel.
6. Mount two 250 watt bulbs in lamp holders. One at each end of a metal cover which rests above the glass cover. The two bulbs will run for about 8 hours a day in the ordinary classroom.
7. Even better visibility is achieved by putting black or grey paper at the back of the trough.
8. Refuse on the gravel can be taken up in a glass tube i.e. by closing the top with finger, pushing the tube down over the refuse, releasing the finger - so that the refuse is pushed up into the tube with the water and then replacing the finger and lifting the tube from the tank or can be siphoned out using rubber tube.
9. It can be cleaned with potassium permanganate.

Common water plants

Valisneria, Ceratophyllum, hydrilla, etc.

Animals

Fishes like Goldfish, Guppies, Platies, Fighters, snails, etc.

Terrarium/Vivarium

It is an artificial ecosystem, consisting of terrestrial animals.

1. A metal tray at the bottom is filled with living turf and a corner or small dish of water, flush with turf and arranged with a few flat stones on the turf and in the water to serve as shelters and hiding places for animals.

2. Here snails, slugs, worms, lizards, toads, frogs and perhaps a tortoise may be kept.

3. Toads and frogs may be fed on living insects.
4. Feed snails on fresh lettuce leaves everyday.

Bulletin boards/Wall magazines

There is a growing emphasis on the methods, techniques and products of science and technology and we have to acquire a general understanding of these. This has been one of the major aims of science education today. The concept of science education outlines a more fundamental understanding of facts, concepts and principles of science, use of scientific methods to solve problems, to develop scientific temper and attitude. Bulletin boards, wall magazines provide some of the basic tools of learning in science. The bulletin boards/wall magazines as the name implies, is a place for bulletins, news-items, announcements, multifarious items and visual displays that are of absorbing interest to the students.

Objectives

1. To motivate and arouse curiosity among the pupils for science.
2. To display graphic and pictorial materials possibly linked up with the curriculum in an attractive manner.
3. To display the articles collected from newspaper regarding journals.
4. To display work done by members.
5. To display reports of individual or group projects.
6. To provide basic means of general communication.
7. To develop habit of thinking, reading, collecting and correlating abilities of the pupils.

Materials required

Ply-wood or fibre board, charts, paper, metal hinges, adhesive tapes, etc. Kit containing scissors, rulers, pins, colours, brushes, copies of articles, of newspaper, magazines, journals, etc.

Forms of articles

Paintings, photographs, paper cuttings, puzzles, game analogies, short fictions, poems, experiments, life-history of scientists, herbarium collections, charts, etc.

The science bulletin board is a learning aid of great educational value. An earnest teacher will not have difficulty in getting suitable display materials. It is a perpetual magazine of the class or the school, designed to give the pupils information of direct concern to them and to arouse their curiosity and desire for knowledge. It should present

an aesthetic unity, a harmony in the layout and illustration of various elements that go in its making. The science bulletin board should be entirely a result of the creative effort of the pupils. It should be a work of the pupils and for the pupils. A committee may be appointed under a dynamic leader hip to collect, select, place for the display of the articles and to file them afterwards. The bulletin board may be of size 5' x 1 1/2' and cover up of either plywood or cardboard preferably with a wooden frame. Apply suitable paint to make it attractive. It should be fitted at a suitable, preferably science room or at the entrance of the main building, well-lighted place and should be at the eye level of the children.

Some of the following hints are to be considered during display of materials on the bulletin board.

1. Be sure to make the design eye-catching and attractive.
2. Gaudy, splashy designs should be avoided.
3. Make the display simple by arranging materials in a neat and orderly manner.
4. Use any design which can bring out its message in 5 to 10 seconds.
5. Be sure to avoid the use of unnecessary decoration or scattering of arrangement.
6. No crowding of display materials.
7. Display materials should be large enough to be seen from a reasonable distance.
8. Should be changed weekly once or twice depending on the importance and size of the display material.
9. Each display should have a suitable title (short and descriptive) name and class of the contributor.
10. Students should be given responsibility to display the articles.
11. Use arrows, colours, interesting shapes, proper lettering to draw attention to special areas.
12. Highlight the main theme by a catchy device. It may be an illustration, caption or text or it may be the brightest or the largest item on the board. Highlight different areas by labels and titles. Display can be made on some selected themes related to science; for example, Pollution, first-aid, genetic engineering, computers, chemistry in daily life, etc.
13. Bulletin boards should grow out of pupil-teacher planning.
14. Develop a picture file, tap all possible sources of materials such as correct pictorial magazines, newspapers, etc.
15. Take a good care of the mechanics of bulletin boards, maintain a bulletin board, a kit containing scissors, rulers, pins, etc.
16. Prizes may be given for good display.

Vocational guidance

Science club can also take up vocational guidance as one of the activities. A group of students may be identified to take up the task. A part of the bulletin board/wall magazine may be used for vocational guidance. Vocational guidance can be given to science club member and can even be extended to non club members by following ways.

1. Arranging guest lectures by employment officers/vocational instructors from employment exchanges/colleges/schools, etc.
2. Display of charts on wall magazines showing various courses which could be taken up by students with different combination of subjects.
3. Display of paper cuttings on wall magazines regarding various competitive examinations, admission notices of various institutions, etc.
4. Visit to research centres, industries, etc. to create interest and to bring general awareness.
5. Arranging counselling for outgoing students by experts.
6. Preparing a list of agencies and placement centres.

Science club libraries

Science club library is a collection of printed or written materials arranged in an organised manner for the purpose of study, experimentation (project/research) and general reading. Science library mainly includes collection of books, magazines, printed materials, films, micro-films, audio cassettes, etc. related to science.

Science club libraries can be established for its members in addition to the departmental and school libraries.

The reasons for establishing a separate science club library are as follows :

1. To provide opportunity to each student for reference work as part of his course, project work or for any other activity related to science.
2. To develop the habit of reading science books, magazines, seeing/listening films/audio cassettes.
3. To promote the habit of preserving various books and non book materials.

Planning

Venue

The science club library must be equipped with a separate room if possible. It should also be provided with cupboards for placing material/books. It should be designed keeping in view of the growing needs. It can be also situated in one of the laboratories.

Timings/Incharge

The science club library should provide its service as much as possible. The library should be opened before and after school hours or at the time of recess and lunch time.

The science club library committee should look after the activities of the library. The committee may suggest science incharge or student members to look after the library activities.

Collection/sources

The collection of books of scientific interest, magazines, journals, reference books, newsletters, newspapers, encyclopedia, dictionaries, films, micro-films, audio cassettes, etc. are to be taken up from the membership contribution. This can also be done by accepting/seeking the aid from voluntary organisations or from other available sources such as students, teachers, parents and other agencies.

Finance/Membership

Membership fee may be collected from club members. Financial resources can be sought from parents, well wishers and other voluntary organisations.

Maintenance

The provision of an efficient science club library service would require the service of a devoted person for its well functioning.

The first step of the club library is to attract students by following three principles.

- i) Principle of interest (by offering materials of students' interest)
- ii) Principle of recency (by offering recent arrivals of books to the notice of the students).
- iii) Principle of novelty (by suggesting innovative and creative ideas) for improvement of the library.

The science club must provide readers accommodation, service to readers, and space for the collections. Clean and pleasant atmosphere with other physical amenities must be provided.

Preservation and distribution

The books and other materials in the science club library must be protected from climatic condition and insects. The books in the science club library should be classified according to the subject matter. The periodicals, magazines, may be allotted separate section. Classification is an important aspect which decides what position in the catalogue a particular book falls for example subject/author/index. The books are usually stamped on the title page and entered in the stock register.

Users (utilization)

The school science club library is primarily meant for members of the club and science teachers. It could also be used by other students subject to the availability of time and space.

Rules and regulations

The science club members should follow the rules given below.

- i. The duration of a loan of book/material must be defined for example a maximum of one week.
- ii. Hours of opening must be defined.
- iii. To prevent damage, tracing or other copying should be allowed only in the library.
- iv. Writing, in, or marking of books must be forbidden.
- v. Losses and damage should be reported at once.

Books for the science club library should be selected keeping in view of the aptitude and interests of the users. Illustrated books and magazines, interesting story books related to science and lives of scientist, are to be kept in the library.

The science club library should have a flexible design. There may be provision to install gadgets like computer, reprographic machines such as photostat, micro film readers etc.

Audio-Visual Aids

Audio-visual aids are a set of materials that supplement the classroom teaching learning process. They are used for effective understanding and generating scientific interest among the student members.

Need

The usual classroom instruction may not fulfill or quench thirst for knowledge and deeper understanding of concepts. The process of listening alone is not sufficient for a better learning and hence there is a need for having a set of materials such as photographs, films, filmstrips, slides, overhead projector, audio cassettes, paintings, etc. which make the classroom teaching-learning process lively.

Screening of educational films

Films related to scientific topics and of general interest like films on wild life, pollution, nuclear reactors, etc., can be screened in special darkrooms provided with projectors and screen. The time, and the name of the film are to be announced in advance to the members. The films prepared by 'Physical Science study curriculum (PSSC)' and 'Chem study', BSCs or locally made films can be screened. They may include motion, magnetic force, atomic structure, etc. The teacher incharge should introduce the film by giving a brief account of it and during the screening he may stop it for a while to explain content part of the film if it is necessary. At the end of the screening either the teacher or one or two members may summarise the film. Then the questions are posed by the teacher to all the members to know the extent of their understanding.

Screening of film strips

The same procedure of the films can be carried out for the film strips.

Preparation of slides

The information can be stored, displayed and preserved in slides with economy of space for a long time. Self-made slides give members good opportunities to express themselves in the field of their interests. Slides can be produced relatively with much less expenses. The close up pictures of insects, leaves, rocks, a table of some data, auto-biographic sheet, the internal structure of a leaf, the arrangement of apparatus in a particular experiment, different geometrical forms, all kinds of section cuttings in Botany, can be attempted.

Photographic plates and films that are not properly exposed can be made use of and the diagram can be drawn on them using indian inks and transparent colours. Similarly, diagram of water cycle, nitrogen cycle, different systems of human body and experiments on light etc. can be drawn on them.

Preparation of audio and video cassettes

Audio and video cassettes can be prepared with the help of State Institute of Educational Training or/and Central Institute of Educational Technology, New Delhi. A topic of interest is to be chosen. Script/teleplay has to be written and put to a thorough discussion among the members and experts. After scrutiny and redrafting if necessary, this can be recorded on the cassettes with the participation of the members after one or two rehearsals. Video-cassetting needs a bit more planning regarding where and how to record.

The topics may or may not be related to the syllabi. But it must help the members for the acquisition of better and useful information.

Audio cassettes play a major role where projection type apparatus are lacking completely. Lectures by eminent persons or a teacher or by a student can be recorded and played whenever it is felt necessary. Life and works of scientists in a story telling manner are more helpful to the members. Some of the topics of science can be recorded in the form of drama, story, autobiography, poem, etc.

Use of computers

In order to cope up with tremendous advancement in the field of science and technology, the use of computers has come as a boon to mankind. Therefore, it is very essential to start the use of computers in school itself.

In the primary level the use of computers may be introduced to play video games, or comics, so as to make the children familiar to the handling of computer. At the secondary level, comparatively detailed knowledge would be necessary.

A teacher preferably with suitable experience in the field of computers and its usage may have to take up the initiative in collecting a group of interested children and teach about the software and hardware.

The teacher incharge may have to introduce a little of basic knowledge and introduce the concept of a flow chart i.e. a programme which has to be fed into the computers. Automatically children will start developing interest and would start using computers as a part and parcel of their

daily lives. For example, they may use computers to learn some of the concepts of science, for calculation, drawing graphs, for preparing reports of the investigatory projects, etc.

Computer classes can be taken either in holidays or after school hours depending on the convenience of the teacher in charge. The teacher can also conduct weekly/monthly tests in order to evaluate the performance of the students, especially in drawing of flow-chart and programming. This activity helps the students to gain confidence in preparing their own programmes.

Uses

1. Experiments in various subjects could be displayed by the computers.
2. Discoveries and/or contributions towards science from individual scientists could be displayed.
3. Various graphics could be depicted.
4. Question banks can be prepared.
5. Evaluation techniques could be programmed and used.
6. Can be used as word processor.
7. Video games related to science can be played.

Preparation and preservation of food

Members of the club learn to prepare different food items. The students can prepare protein rich food from the locally available items by referring the articles of NIN (National Institute of Nutrition, Hyderabad). Club members can develop them from locally available resources.

Importance

1. By this the participants of the club will know the nutritive value of different locally available food items.
2. Participants will understand the adulteration of different food items, method of their detection, various diseases caused by them.
3. The participants will apply the methods of preservation in their day-to-day life and also educate the community in all the above activities.
4. These activities/items could be exhibited and sold at the end in the school science exhibition.

Inventories in science club

For conducting science club activities the incharge science teacher should invariably acquaint himself/herself with the available physical/material/human resources in and around the school. Such knowledge of resources would help him in conducting club activities smoothly and effectively. An inventory helps the incharge science teacher to keep abreast of the locally available resources.

Objectives

1. To acquaint the teacher/coordinator with the available resources in the school and in the community.
2. To help for the optimum utilisation of the available resources.
3. To understand the mechanism/utility of the equipment.
4. To provide necessary information about the resources so that they can be utilised by the neighbouring schools where such facilities are not available.
5. It helps the teacher to know the present status of the resources.
6. To help the teacher to adopt new strategies/technique of teaching for providing effective learning experience to students.

Who will prepare an inventory?

Science club incharge/coordinator should take up the task of preparing such lists with the help of club members.

How to prepare?

Students/club members may be divided into small groups of 4-5 members and each group may be entrusted with the task of collecting information required.

When to prepare?

These lists may be prepared at the beginning of an academic year, and be revised every year suitably making deletions/additions, if any, to the list.

Suggested inventories

1. AV aids
2. Charts
3. Models
4. Science kits
5. Improvisation
6. Low cost aids
7. Video/audio cassettes
8. Chemicals
9. Permanent slides
10. Specimens
11. Science books
12. Activity Manuals
13. Newspaper cuttings
14. Science newsletters
15. Books on science projects
16. Science journals

Apart from this community resources like halls/auditorium and people of professional expertise, village elders, voluntary organisations, etc. may be added to the list.

Guidelines for effective use

1. The lists should be displayed in the room wherein the science club activities are organised, staff rooms and on notice boards for publicity.
2. The lists should be revised atleast once in four months or a year.
3. Parent-teacher association meetings may be organised once in a quarter for the club activities; and for optimum utilisation of community resources/expertise.
4. The lists prepared should be as per the proforma shown below.

Sr. No.	Name of the item	No. of items	Where they are available	Their utility	Remarks
1	2	3	4	5	6

Science club members can also take part in the activities of other clubs/institutions. But such activities are to be carefully planned so that they do not interfere with normal activities of the club. They can be supplementary. Some of them are mentioned below.

1. Organization of field trips, competitions, seminars, etc in association with other clubs of the school.
2. Participation in the activities of WWF (World Wildlife fund), BWC (Beauty without cruelty), SPCA (Society for prevention of cruelty to animals) and Science JATHA.
3. Starting a 'Nature's Club' and registering it under 'Nature Clubs of India' (NCI) in collection with 'Nature Club Movements'.
4. Participating in the activities of youth associations, local voluntary organizations such as rotary clubs, lions club, etc.

Public shows, fun fairs, role play, drama, puppet, fancy dress, etc. can be conducted as inter-club activities.

V Evaluation of the science club programmes

Appraisal of the attempt of the club activities towards achieving stated objectives is very essential. It gives feed-back to reformulate the objectives, rethink, re-organise, replan the action plan and to modify the procedures of implementation.

For evaluation of the club activities, the following strategies can be adopted.

1. Collection of opinion
2. Judgement of experts
3. Interviewing the experts
4. Result of inter-club competition
5. Check-list/questionnaire

Collection of opinion

A box can be kept in the club inviting the comments and suggestions if any regarding the organisation of the club, planning and implementation of the activities. A book can also be kept to give the suggestions and comments on the science club activities for the public as and when they visit.

An evaluation committee can be appointed to verify and analyse the club activities (the comments and suggestions given in the opinion box/book have to be considered) and submit a brief report with suggestions to the executive body.

Judgement of the experts

Reports of various activities such as field trips, projects, surveys, collections, papers, scrap books, albums, etc. are displayed once in a year for the whole school and the public. A panel of judges selected by the executive body may evaluate the group/individual performance based on the report/work displayed. Criteria for the evaluation could be chalked out considering originality, technicality, way of presentation, etc.

Interview by experts

Experts are interviewed about the programme of the club by the secretary/any executive member whenever they are called for talk/interview sessions.

Result of inter club competitions

Members of the club may participate in various inter-club competitions and from their results the standard of the club activities can be judged.

Check-list/Questionnaire

A check-list or questionnaire can be used to appraise the programmes of the science club in which the situations/questions are given related to the objectives, organisation, planning and implementation of activities, evaluation criteria, etc. An example of such a questionnaire is given below.

Questionnaire for evaluation of science club

	Fully Agree	Partially Agree	Disagree
1. All the members shared a sense of purpose.			
2. All the major objectives are fulfilled by the activities of the club.			
3. The physical facilities are inadequate.			
4. There is no difficulty in getting a sponsor for the club.			
5. Size of the club is too large.			

Fully Agree	Partially Agree	Disagree
----------------	--------------------	----------

6. Specific qualifications are not laid down for the membership.
7. Members do not attend meetings regularly.
8. Members do not actively participate in the club activities.
9. All the executive members are active and enthusiastic.
10. Executive members do not take unilateral decisions regarding the club.
11. All the committees discharge their responsibilities successfully.
12. The timings of the meetings are proper.
13. The frequency of meetings is to be increased.
14. Special meetings are called as and when required.
15. Financial assistance from school management/government/other sources is adequate for running up of the science club.
16. Some of the activities of the club fetched money and added to the club fund.
17. Membership fee is too high.
18. Rules and regulations are to be modified.
19. Sponsor of the club is a dynamic person.
20. Planning of the programme is not proper.

1
1
1

Fully	Partially	Disagree
Agree	Agree	

21. Duration of the club activities is too short.
22. Plan of action for the year is too ambitious.
23. Many activities of the action plan could not be carried out.
24. Review of the club activities is done.
25. Criteria for evaluation of club activities is proper.
26. Proper feedback to improve science club activities is given time to time by the executive body.

The result of evaluation should be taken by all the members in a positive way which enables them to engage in constructive activities to improve the programme of the club.

References

1. Modern Science Teaching - R C Sarma (Dhanpat Rai & Sons Delhi).
2. Science Teachers Hand-book - C S Rao (American Peace Corps, 1968).
3. A.V. aids for Scientific and Technical Education (NCERT - S L Ahluwalia).
4. Meals for the family - by SCERT, AP, Hyderabad.
5. Resources Book for SUPW - NCERT Publication.
6. Experiments without Explosions - O M Olgin (MIR Publishers, Moscow).
7. Secondary School Science Teaching - Arthur G Hoff (The Bkxiston Company).
8. Modern Science Teaching - E.D.Heiss, E.S.Obourn and E.,W. Hoffman (Macmillan, New York, 1950).
9. Teaching Science in today's Secondary Schools - Walter A Thurber ; Alfred T Collette (Prentice Hall of India, New Delhi 1964).
10. Teaching Science to the Ordinary People - Laybourn and Bailey (University of London Press Ltd.)
11. Science and Technology - Education through Exhibitions - P K Bhattacharya (NCERT)
12. The teaching of Physics in Tropical Secondary Schools - N F Boulind (Oxford University Press).
13. Handbook for Science Teachers in Secondary Modern Schools - Gordon Nunn (John Murray, London).
14. Inquiry Techniques for Teaching Science - W.D.Roney (Prentice Hall, India).
15. Popularisation of Science through Science clubs - Watson (UNESCO).
16. The Teaching of Biology in Tropical Secondary Schools - T L Green, (Oxford University Press).
17. Innovation in Science Teaching - R M Kalra (Oxford IBM, New Delhi).
18. Free and Inexpensive Educational Aids - Thomas J Pepe (Bever Publications).
19. New Education and School Library - S R Ranqanathan.

20. The High School Library, its-Organisation and Administration - C G Viswanathan.
21. Fun with Science (Written in Telugu) - Pallabhiram.
22. Laboratory 'in every house (written in Telugu) - M Nalini Mohan.

APPENDIX

Name of the Magazine	Publisher
1. Junior Scientist (Monthly)	S Nairajan Memorial Committee, STIU Council of Educational Research, 169, R K Mutt Road, Madras - 28.
2. Invention Intelligence (Monthly)	National Research Development Corporation of India, 20, Ring Road, New Delhi.
3. Science Reporter (Monthly)	CSIR, Science Reporter, PID Building Hill Side Road, New Delhi 110006
4. School Science (Quarterly)	NCERT, Sri Aurobindo Marg, New Delhi 110016
5. Science Gem (Monthly)	Shri Sushil Mohan, C 371, Defence Colony, New Delhi 24.
6. Science Health (Quarterly)	4, Deen Dayal Upadhyaya Marg, New Delhi 110002.
7. Indian Farming (Monthly)	S S Grewal, Under Secretary, Indian Council of Agricultural Research, Krishi Bhavan, New Delhi.
8. Electronics for you (Monthly)	E.F.Y. Enterprises Pvt. Ltd. N.P.L., New Delhi 110019.
9. Spice (Quarterly)	Publication Officer (G) District Office Road, Bangalore.
10. Every Man's Science (Monthly)	Indian Science Congress Association, 14, Bireesh Guha Road, Calcutta 700017.
11. Science	A.P.C. Road, Calcutta.
12. Vignani Pragati (Hindi)	CSIR, New Delhi.
13. Science KiDuniya (Hindi)	CSIR, New Delhi.
14. Popular Science & Technology	DESIDOC
15. Science/Today (English)	Times of India Group, Bombay.
16. Jago Aur Jagao (Hindi)	Adult Education Association

- | | |
|-----------------------------|--|
| 17. Chakmak (Hindi) | F-1/208, Area Colony,
Bhopal 462 016. |
| 18. Kheti (Hindi) | SCAR |
| 19. Phul Phool (Hindi) | ICAR |
| 20. Krishi Chayanika(Hindi) | SCAR |

Indian newspapers these days highlight developments in science and technology in simple language. Some dailies print interesting supplements on science and technology news on a particular day of the week. We would listen to talks, discussions by scientists, science quiz and interviews on science and technology events on the AIR and telecasts like UGC programmes by Doordarshan.

List of museums worth visiting.

1. Visweswarayya Industrial and Technological Museum, Bangalore.
2. Indian Museum, Calcutta.
3. Birla Science Museum, Hyderabad.
4. Zoological Museum, Calcutta.
5. National Museum, New Delhi.
6. Birla Industrial and Technological Museum, Calcutta.
7. Ekulavya Museum, Madhya Pradesh.
8. Kerala Jana Vigyana Samithi, Kerala.
9. Jawahar Bal Bhavan, Hyderabad
10. Heallih Museum, Hyderabad.
11. A P Academy of Sciences, Osmania University Campus, Hyderabad.
12. A P Science Centres _ Each district of Andhra Pradesh
13. National Museum of Natural History, New Delhi.

Action Plan of Science Club (1991-92)

(Space Central School, Sriharikota)

Sl. No.	Month	Activity	Remarks
	August 1991	<ol style="list-style-type: none"> 1. Inauguration 2. Essay competition VII-VIII & IX XII 3. Initiation of Wall Magazine. 	Topic will be given five days in advance
	September 1991	<ol style="list-style-type: none"> 1. Initiation of Science Club Magazine 2. Science Debate IX X and XI XII 3. Visit to Policatnagar 4. Guest lectures from SHAR unit. 	Topic will be given two days in advance
	October 1991	<ol style="list-style-type: none"> 1. Science drawing competition VI VIII and IX XII (Wild life) 2. Forest Trip 	On the spot competition
4.	November 1991	<ol style="list-style-type: none"> 1. Caption Competition (VI XII) 2. Guest lecture from SHAR unit 3. Display of Herbarium 	
5.	January 1992	<ol style="list-style-type: none"> 1. Project exhibition on 1st January. 2. Flower show competition on January 26th. 3. Finalization of Prize list. 4. Visit to Madras Museum. 5. Guest lecture from SHAR unit. 6. Distribution of Health Pamphlets. 	Celebration of Environmental Awareness month
	February 1992	<ol style="list-style-type: none"> 1. Science exhibition 2. Model Rocketry programme 3. Science magic show 4. Valedictory function <ul style="list-style-type: none"> - Honouring Dr. Ramamurthy - Prize distribution Release of magazine 	Celebration of National Science Day
	March 1992	Review meeting	

Science club activities of a school

Name of the School : Space Central School, Sriharikota.

Regular features of science club are

I. Competitions

1. Science debate
2. Science elocution
3. Science essay writing
4. Science quiz
5. Flower arrangement
6. Wild life painting
7. Nature painting
8. Model making
9. Poster and slogan

II. Outings

1. Excursions (Kalpakkam Atomic Power Plant, Madras Museum, Planetarium, etc.)
2. Field trips (Tirumala Hills, Local Forests, Beach).
3. Visit to local places of scientific importance (Spinning mill., nursery, water plant, etc.)
4. Special outings (bird watching, cycling, etc.).
5. Trips to science exhibitions (Tirupati, Madras).
6. Visits to medical exhibitions (Tirupati).

III. Exhibitions

1. Science exhibitions on National Science Day.
2. Thematic Exhibitions (Food and Fun)
3. Science Exhibitions for Public.
4. Exhibition of Best Science Projects on 1st January.

IV. Celebrations

1. National Science Day (Exhibitions, Processions, Lectures).
2. Environmental Day (Slogans, Paintings, Processions).

V. Special Programmes

1. Guest Lectures by Scientists, Engineers, etc.
2. Special lectures by ex-students (medical, engineering, IIT, IAS, etc.).
3. Meet the Doctor Programme (Doubt clarification by specialists).
4. Specimen collection from local areas.
5. Skill games involving science (Memory tests)
6. Demonstration of science experiments to primary class students.
7. Collection of insects, shells, rocks and other important specimens from local areas and places of visit.

VI. Science popularization programmes

1. Model rocketry programme (by JNESCO).
2. Mini planetarium programme (by JNESCO).
3. Kitchen garden development
4. Preparation and distribution of pamphlets on health (e.g. hair care, oral hygiene, vaccination schedule, Madras eye, etc.).
5. Science news in school assembly.

VII. Audio-visual programmes

1. Science film shows to children
2. Video shows to children
3. Video programmes for teachers
4. Introduction to O H P.

VIII Other programmes

1. Preparation of Science Club House Magazine (incorporating all activities from inauguration to valedictory functions).
2. Science Club Wall Magazine: Regular display of articles, paper cuttings, photos, jokes (science) principles - prizes for best displays.
3. Display of Best Herbarium collection from life science students.
4. Establishment of School Science Museum with collected specimens, models, projects charts, toys, articles, instruments, etc.
5. Projects and emphasis on wealth from waste.
 - Model making with paper pulp
 - Toys, curtains, etc. with shells, stones.

6. Science programmes for poor
 - smokeless chullah
 - Poorman's fridge
 - Poorman's water filter
 - Collection and distribution of clothes, combs, etc. to local Yanadi people.
7. Honoring local people who have served the poor - doctors, forest officials, etc.
8. Sanitation programmes - cleaning dirty streets - vegetable market, pollution analysis.
9. Collection of unexpired and unused drugs from employees.
10. Encouraging innovative ideas in science among students.
11. Helping librarian in procurement of science magazines.
12. Participation in the activities of WWF, NCI, BWC and SUPW.
13. Plantation programme.

WORKSHOP ON PREPARATION OF HAND BOOK FOR
SCIENCE CLUB ACTIVITIES

held at SCERT, HYDERABAD
FROM 27.1.1993 TO 3.2.1993

Academic Coordinator :

Dr.C.A.Padmanabha Rao
Field Adviser (NCERT)
Hyderabad

Resource Persons :

1. Dr Sabita Prava Patnaik
Lecturer in Education
Regional College of Education
Mysore 570 006
2. Dr J Seetharamappa
Lecturer in Chemistry
Regional College of Education
Mysore 570 006
3. Dr K Z Chisty
Asst. Field Adviser
NCERT, Hyderabad-29

List of Participants

1. L Krishnaveni
PGT (Biology)
A P Residential School (Girls)
Kammanapalle 517 415
Chittoor District, A.P.
2. Dh Siva Prasad
School Assistant (Biology)
Govt. High School for Boys
Rajahmundry 533 101
East Godavari District, A.P.
3. K S V Satyanarayana
School Assistant (Phy. Science)
Z P P High School
Dosakayalapalli (PO)
Korukond Mandal 533 292
East Godavari District, A.P.
4. D Subrahmanyam
Headmaster
Z P P High School
Konteru (Via) Palakol 534 261
West Godavari District, A.P.
5. A Jagannath Singh
Science Consultant
Govt. Comp. College of Education
Nellore, A.P.
6. M Satyanarayana
School Assistant (Phy. Science)
Govt. High School for Boys
B Camp, Kurnool, A.P.
7. B Satyanarayana
School Assistant (Biology)
Z P P High School (Boys)
Tanuku 534 211, A.P.
8. D Sudha
IGT (Phy. Science)
A. P. Residential School (Girls)
Bhadrachalam 507 112
Khammam District, A.P.

9. S Ramakrishna Upadhyaya
PGT (Physics)
Space Central School
Sriharikota 524 124
Nellore District, A.P.
10. G Krishna Mohan Rao
PGT (Biology)
Space Central School
Sriharikota 524 124
Nellore District, A.P.
11. G Indira
PGT (Physics)
Kendriya Vidyalaya
No.1, Uppal
Hyderabad
12. Devika Aaron
PGT (Chemistry)
Kendriya Vidyalaya
Picket
Secunderabad, A.P.
13. Dr.P V Rama Rao
Lecturer in Chemistry
Dept. of Science & Maths
SCERT
Hyderabad, A.P.
14. Dr J Nagalakshmi
Lecturer in Biology
Dept. of Science & Maths
SCERT
Hyderabad, A.P.
15. P Ramulu
Asst. Lecturer (Maths)
Dept. of Science & Maths
SCERT
Hyderabad, A.P.

Special Participant

G.Ganapathi Rao
Lecturer, SCERT
Hyderabad, A.P.